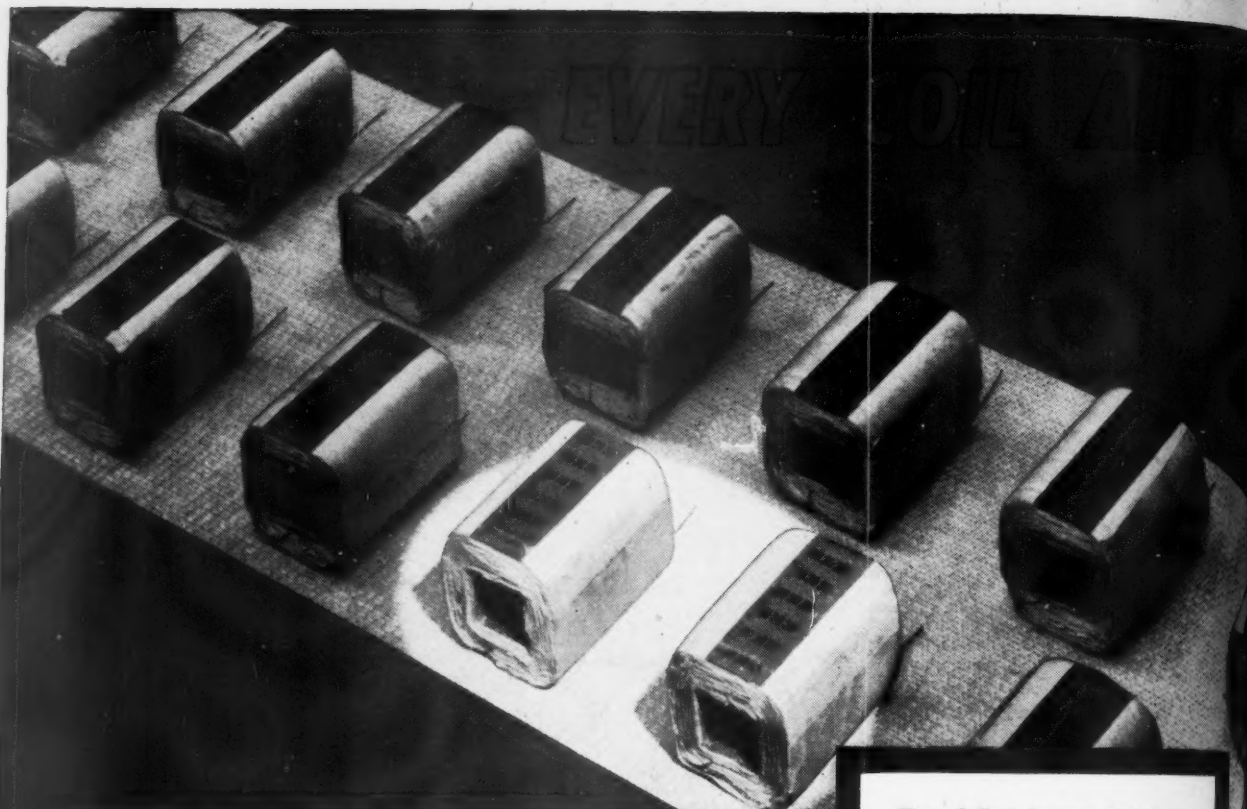


DECEMBER • 1945

THE MAGAZINE OF ELECTRICAL CONSTRUCTION & MAINTENANCE



THIS ISSUE: NEC's meeting at Cleveland's complete report; energy efficiency control; a slim-line lighting installation; cutting costs on pumps and controls; fresh frequency heating.



ANOTHER reason why G-E BALLASTS add reliability to your fluorescent fixtures

THESE ballast coils—picked at random from a production run—are identical. This is not a matter of chance.

These coils are automatically wound by a machine that pre-determines the number of copper-wire turns for every coil layer, that spaces these turns exactly, and feeds in layer insulation at just the right instant. Constant tension is maintained on the coil wire as it feeds on to the specially constructed winding spool so that every finished coil is exact in size, smooth, compact, and evenly rectangular. No rounded sides, no "springy" layers.

Long lamp life; rated light output. This uniformity of coil design is one important reason why every G-E ballast has electrical characteristics perfectly matched with the lamp it is to operate—a "must" to assure long lamp life and rated light output.

Improved ballast life. Matched characteristics contribute, also, to uniformly long ballast life—prevent early burnouts. It is features like this that are responsible for the fact that more than one billion watts of fluorescent lighting are being satisfactorily operated today with G-E ballasts. More than 150 lighting equipment manufacturers rely on G.E. for all or part of their ballast requirements.

For complete data on G-E ballasts, ask for GEA-3293F. Apparatus Dept., General Electric Co., Schenectady 5, N. Y.

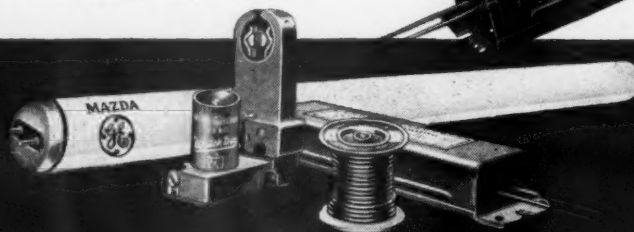
These ballast features help keep fixture users satisfied—they mean added profits for you

1. Low noise level—for satisfied users
2. Long life—for low replacement cost
3. Characteristics matched with lamp—for rated lamp life and light output
4. Dimensions that permit use of one wiring channel for practically all fixtures—for simplified parts inventory and lower fixture cost



BALLASTS
LAMPS
STARTERS
LAMP HOLDERS
CABLE

for DEPENDABILITY in fluorescent lighting



Buy all the BONDS you can
—and keep all you buy



GENERAL ELECTRIC

Whit
fact
fo
ELECTRICAL
GUARANTEE
Electrical Co.
for three y
three years
matter Aug

"A FIRST CLASS INSTALLATION," *say electricians* (and they also say, "SO EASY TO PUT IN")



Arc-quenching construction in 2, 3 and 4 Pole, 30, 60 and 100 Ampere Safety Switches.

SKETCHED above is the switch block from a Murray Single Throw, Fusible, Type D, Safety Switch. In the circle is the outstanding feature — the double break blade and arc quenching chamber. Each blade is provided with a double break — the arc is broken into two parts. The burning is greatly reduced by this feature. Whatever arc is formed at each of the two breaks is drawn into a narrow slot in the mounting base where it is lengthened-out and cooled — the effects co-acting to quench the arc almost instantly. This arc-quenching construction coupled with those Murray Switch characteristics as ample wiring room, properly placed knockouts, good-looking cabinets, assure the electrician the satisfaction that comes from a first-class installation. Metropolitan Device Corporation, Brooklyn, New York.

Murray
SAFETY SWITCHES
THERE ARE MURRAY JOBSERS EVERYWHERE

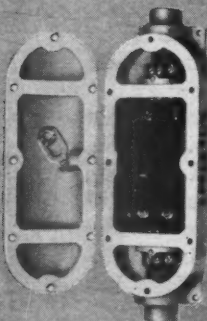
BUILT-IN SAFETY

for Hazardous Locations!

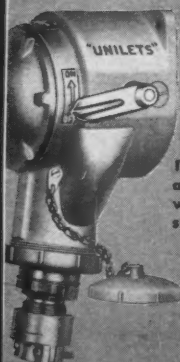
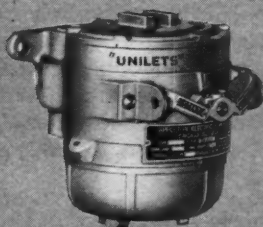


Skilfully designed, ruggedly built Explosion-Proof Fixtures for every location—including the exclusive Fluorescent type—first of its kind in America.

Type ARTC, "SEAL-LINE" Explosion-Proof Circuit Breaking Switch Unilet. Below, cover removed to show roomy wiring chambers with center switch chamber isolated in approved explosion-proof method.



Right, Type OCF Unilet, Explosion-Proof, Dust-Tight, oil-immersed or air-break momentary switch. Removable close-up plug for either dead-end or through-feed wiring.



Type FSQX Explosion-Proof and Dust-Tight Receptacle with interlocking safety switch and type FP Plug.



Approved by Underwriters' Laboratories



APPLETON

EXPLOSION-PROOF EQUIPMENT

Gives a Wide Margin of Safety

Make reconversion and new construction jobs in hazardous locations permanently safe, with Appleton Explosion-Proof Fittings and Fixtures! They offer a wide margin of safety and protection in oil refineries, chemical plants, wherever combustible dusts or vapors threaten personnel and property.

Skilfully designed Appleton Explosion-Proof equipment is well-known for its long, dependable service and efficient operation. Rugged cast malleable bodies are produced in

Appleton's own foundries, other parts in Appleton fabricating plants where their high quality is carefully controlled and maintained. They are approved by Underwriters' Laboratories and conform to all exacting code requirements.

The complete Appleton line offers the right fitting for every requirement, hazardous or otherwise. Save valuable time by making Appleton your No. 1 source for every job. Remember, Appleton fittings are "STANDARD FOR BETTER WIRING".

Sold Through Wholesalers

APPLETON ELECTRIC COMPANY

1704 WELLINGTON AVENUE • CHICAGO 13, ILLINOIS

Branch Offices: NEW YORK, 76 Ninth Avenue • DETROIT, 7310 Woodward Avenue • CLEVELAND, 1836 East Avenue • SAN FRANCISCO, 655 Minna Street • ST. LOUIS, 420 Frisco Bldg. • LOS ANGELES, 100 West Santa Fe Avenue • ATLANTA, 203 Luckie Street, N. W. • BIRMINGHAM, 6 N. Twenty-first Street • MINNEAPOLIS, 305 Fifth Street, S. • PITTSBURGH, 418 Bessemer Bldg. • BALTIMORE, 100 East Pennsylvania Street • BOSTON, 10 High Street • DENVER, 1536 Sixteenth Street • PHILADELPHIA, 1217 Race Street

Resident Representatives: Cincinnati, Dallas, Kansas City, Milwaukee, New Haven, New Orleans, Seattle.



Write for the Appleton Catalog.
Complete descriptions of 15,000 items



APPLETON

CONDUIT FITTINGS • OUTLET AND SWITCH BOXES • EXPLOSION-PROOF FITTINGS • REELITES

Electrical Contracting

With which is consolidated The Electrician and Electrical Record Established 1901

Contents for December, 1945

December—at a glance 41

Era of Control—An Editorial 43

NECA Convention Report 45

A complete report of the 44th Annual Meeting of the National Electrical Contractors Association together with abstracts of papers presented.

What's in the '46 Code 54

By GEORGE ANDRAE—Previewing revisions and new subjects for the National Electrical Code to be issued next year.

Team Work Wanted 56

By S. C. SACHS—Contractors must shoulder full load and responsibility in sales effort to merit share in profits of distribution.

Slimline Sells Sporting Goods 57

By AUGUST ECKEL—Model store lighting project in St. Louis features new type fluorescent lamps in a modern planned lighting layout.

Tolerance Control Through Electronic Tubes 62

Vacuum tube timers on radius grinders boost quality control at a Chicago bearing plant.

How Much Will It Cost—Part III 64

By RAY ASHLEY—Panelboards and cabinets are discussed in this article.

Commutator Brush Maintenance 71

By D. E. STAFFORD—Proper spring compression and properties of brush materials are important factors in preventing brush wear.

Industrial Electrification 141

High Frequency Heating—I

Departments

Practical Methods 72 Reader's Quiz 154

Data Sheets 81, 148, 152 Questions on the Code 163

Motor Shops 113 Electronics 173

Modern Lighting 123 In the News 181

Equipment News 135 Manufacturers News 212

Advertisers' Index 228

W. T. Stuart Editor
Alice McMullen Associate Editor
Berion C. Cooper Eastern Editor
August Eckel Middle West Editor
W. A. Cyr Pacific Coast Editor
H. W. Young Southwest Editor
Harry Phillips Art Editor
Lee H. Hill Publisher
M. S. MacNaught Manager

DISTRICT MANAGERS

S. A. Jones New York
F. J. Seiler Cleveland
W. B. Heaps Chicago
A. B. Conklin, Jr. On Leave U. S. Army

McGraw-Hill Publishing Company, Inc.

JAMES H. McGRAW, Founder and Honorary Chairman; JAMES H. McGRAW, Jr., President; CURTIS W. McGRAW, Senior Vice-President and Treasurer; HOWARD EHRLICH, Vice-President (for business operations); WILLARD CHEVALIER, Vice-President (for editorial operations); JOSEPH A. GERARDI, Secretary; J. E. BLACKBURN, Jr., Director of Circulation. Publication Office, 99-129 North Broadway, Albany, N. Y. Editorial and Executive Offices, 330 W. 42nd St., New York 18, N. Y. Branch Offices: 520 North Michigan Ave., Chicago 11; 68 Post St., San Francisco 4; Aldwych House, Aldwych, London, W.C. 2; Washington, Philadelphia 2; Cleveland 15; Detroit 26; St. Louis 8; Boston 16; Atlanta 2; Los Angeles 13; Pittsburgh 22; Member A.B.C. Member A.B.P.

A practical technical and management journal for electrical contractors, industrial electricians, inspectors, engineers and motor shops, covering engineering, installation, repairing, maintenance and management in the field of electrical construction and maintenance.

**YOUR DESK-TOP
LAYOUT...**



Buy From Sight, a

**SEE WHAT'S AVAILABLE! EXPERIMENT WITH VARIOUS
ARRANGEMENTS! MAKE COMPARISONS! BUILD SOLU-
TIONS! THAT'S THE SIMPLE, IDEA-STIMULATING PROCEDURE
WHEN YOU USE ALLIS-CHALMERS' "UNIT SUB BUILDER" SET
TO HELP YOU SOLVE YOUR POWER DISTRIBUTION PROBLEMS.**

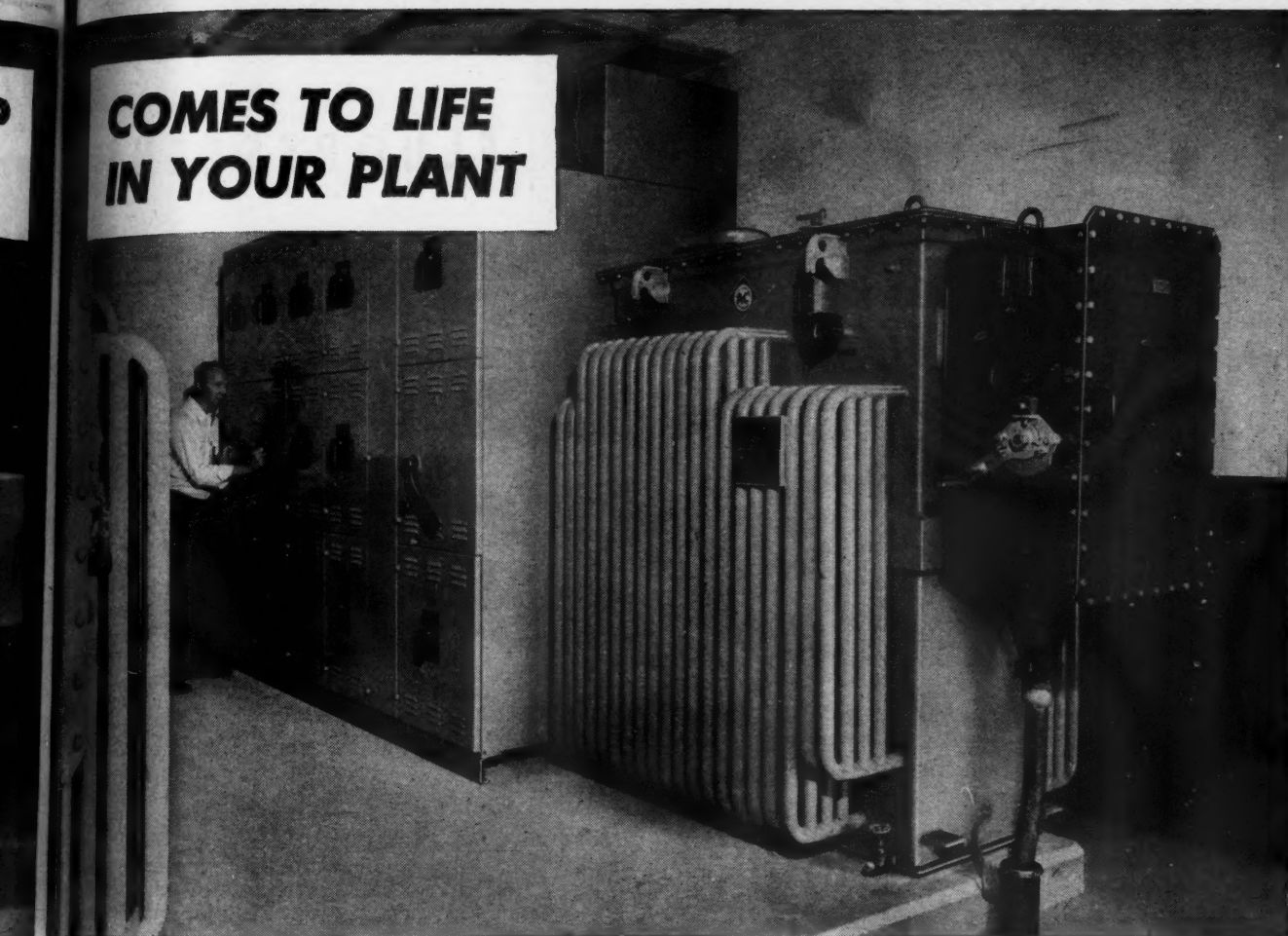
VISUAL PLANNING of your power distribution needs is simple, practical, fast—when you use Allis-Chalmers' "Unit Sub Builder" Set.

With accurate scale models of A-C Prefabricated Load Center Unit Substation apparatus, you see what's available, experiment with various arrangements, make comparisons,

build solutions . . . *right on the top of your desk!*

What's more important: A-C models — accurately scaled $\frac{1}{2}$ inch to 1 foot — protect you against costly power distribution mistakes by letting you see what you are getting in terms of dimensions, characteristics, appearance. You make sure that the substation you select is the *right* one for

**COMES TO LIFE
IN YOUR PLANT**



Stand Buy Right!

—with

ALLIS- CHALMERS

Unit Sub Builder

Set

your needs. You pre-test your load center unit sub ideas.

For the last word in visualization, you can have a floor plan of your factory drawn to the same scale as the models. You can build up your unit substation *right where it will stand*.

All of the elements making up Allis-Chalmers unit sub equipment are contained — in miniature — in the model kit. In addition, there's a handy "Unit Sub Slide Rule" to simplify breaker calculation, and a valuable "Unit Sub Check list" to give you the added planning safety of a double check.

This complete *and proven* service is yours with no obligation. To see for yourself how the models, check list, and slide rule can help you in the correct planning of your power distribution system, call your nearby Allis-Chalmers district office.

An A-C field engineer will bring the models, together with the handy slide rule and check list to your office for a showing. There's no obligation, of course, ALLIS-CHALMERS Mfg. Co., MILWAUKEE 1, WISCONSIN.

A 1948

HEAR THE BOSTON SYMPHONY: Every Saturday Evening, American Broadcasting Co.

FIRST ON THE MARKET!

NEW

Compco

FLUORESCENT
LAMP & STARTER

TESTER★

★ EVERY CONTRACTOR,
ELECTRICIAN, AND
MAINTENANCE MAN
should own a Compco
Tester. Its time-and-
money-saving features,
besides the elimination of
guesswork in fluorescent
tube handling make the
Compco Tester a "must"
for you.

★ HANDY COUNTER
SIZE 5½" x 11"

Shipping weight
only 5 lbs.

COMPLETELY
SELF-
CONTAINED
UNIT

★ TESTS ALL STANDARD SIZE LAMPS

Here it is—the tester you've
been waiting for. The instru-
ment that can test *all* standard
size lamps, eliminating guess-
work in determining the operat-
ing ability of fluorescent lamps
and starters. In the brief space
of a minute you or your custom-
ers can test: 14 watt—15" length;
15 watt—18" length; 20 watt—
24" length; 30 watt—36" length;
40 watt—48" length. Anyone
can operate the Compco tester
... it does the job quickly and
accurately.

★ TESTS STARTERS

Starter socket on the same in-
strument board enables you or
your customers to test FS-2 for
14, 15, 20 watt lamps, FS-4 for
30 and 40 watt lamps, and
"No-Blink" Starters.



Manufactured By
**COMMERCIAL METAL
PRODUCTS COMPANY**

2251 W. St. Paul Ave., Chicago 47, Illinois

SOLD EXCLUSIVELY THROUGH WHOLESALE DISTRIBUTORS

Put them where you want them!

1 ON OVERHEAD STRUCTURES, up out of the way! When you install Allis-Chalmers Dry-Type Transformers *right at load centers* you *step-up* motor and lamp performance... eliminate long, *costly* runs of heavy secondary copper.

2 UP ON POSTS, because they're: 1) small; 2) lightweight; 3) won't drip. These flexible units require no insulating liquids... have nothing to test, filter, or change. And they're *safe*... no fireproof vaults to construct!

3 ON OR NEXT TO MACHINES. Yes, Allis-Chalmers Dry-Type Transformers are available in sizes small enough to fit almost any space requirement. Why not get *complete* details today. Call or write for Bulletin B6027. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 1840

ALLIS  CHALMERS

*Dry-Type
Transformers*

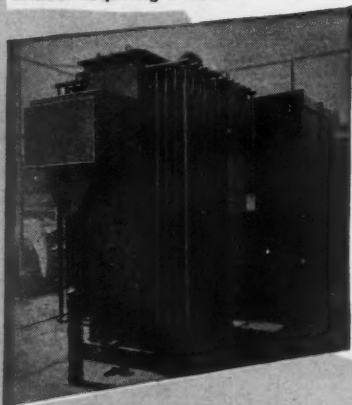
RE-POWERED

at less cost than patchwork!

Load-center distribution system supplanting old-time system step-by-step will pay the full costs of replacement



Unit substations are easy to install; the use of Pyranol* or dry-type transformer sections, with safety metal-enclosed switchgear, permits them to be located on the factory floor adjacent to the load areas, on balconies, or in basements without requiring a vault.



Where building layout makes it desirable, unit substations are built for installation outdoors.

*Pyranol is the G-E trade mark (Reg. U. S. Pat. Off.) for askarel, a nonflammable, nonsludging insulating liquid.

Like many older plants of moderate size, this one was saddled with an obsolete power, distribution system. A recent rise in power requirements, necessitating extensive additions to the old system, brought the problem of replacement to a head.

A study by G-E engineers showed the wastefulness of extending the outdated 2-phase system with 5-wire feeders such as originally used. Instead, they suggested a *step-by-step* plan for converting to load-center power distribution. This conversion plan is paying its own way right from the start.

1. The immediate need for extra power is being met with a new G-E load-center unit substation. The customer saved 5 per cent on first cost alone by buying standard three-phase equipment for the expanded main service. The total cost of *all* the three-phase high-voltage feeders was less than the cost of just the low-voltage two-phase extension, had the need been met by patchwork.

2. Later, additional load-center unit substations will be installed, until the old system is entirely supplanted. Savings resulting from the 2½ to 5 per cent extra efficiency of the three-phase system will amount to \$2000 to \$4000 per year in power costs alone. This will pay off the costs of complete modernization at some 20 per cent per year.

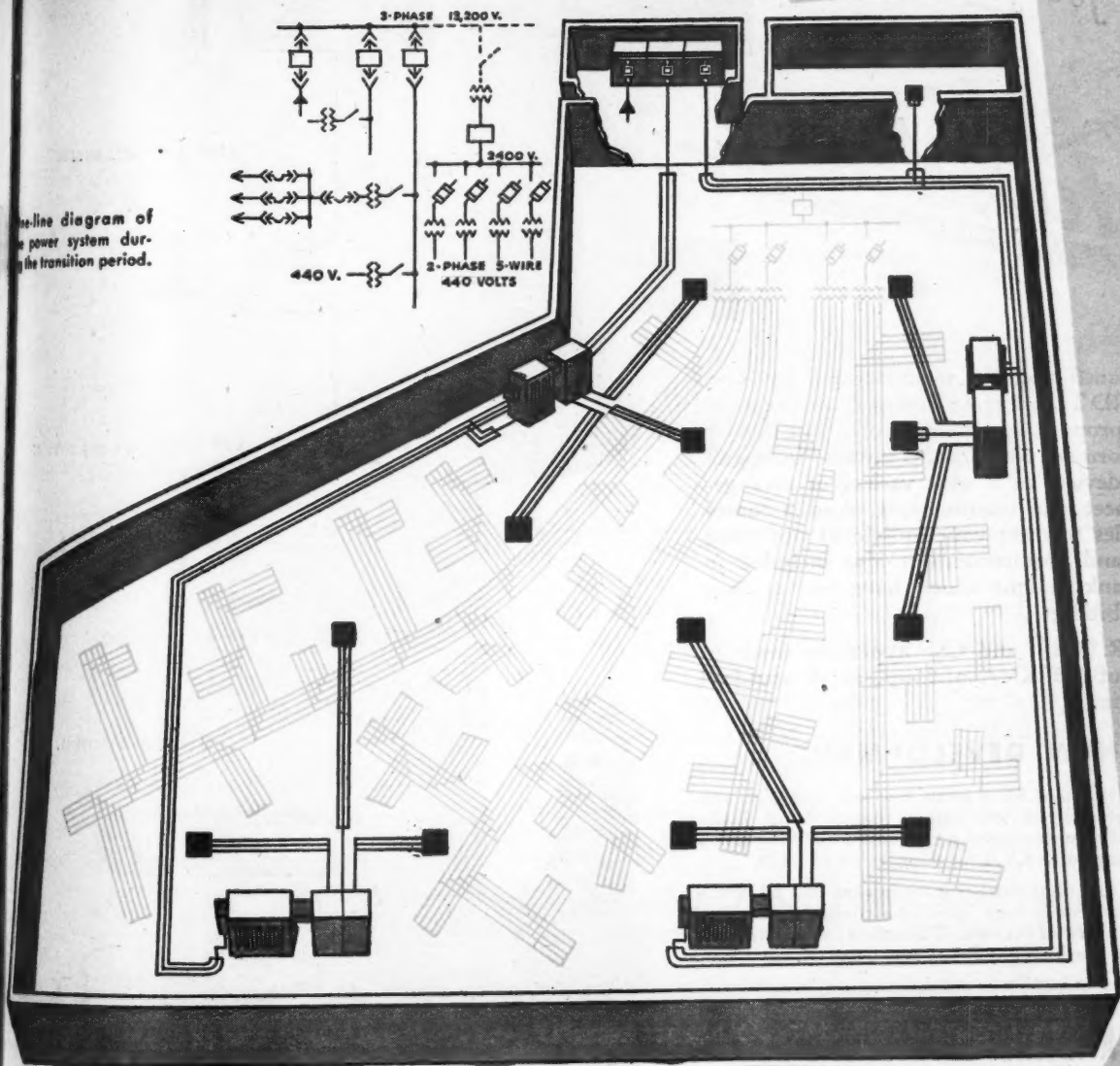
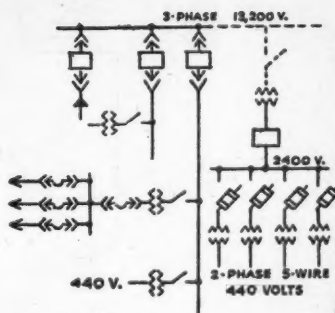
The changeover is being made without production shutdowns during installation of the three-phase system, or in the changeover from the obsolete system. The new system will be safer, and require less servicing time. When completed, the customer will have a power distribution system *engineered for growth*, whatever the extent of the plant's future power needs.

What does a check-up of your own power distribution system show as to voltage conditions, outages, maintenance costs, and restrictions on plant expansion? Perhaps modernization the load-center way can be planned so as to be fully self-liquidating. Ask your local G-E representative, or write for Bulletin GEA-3758. Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

KEEP ON BUYING BONDS — AND KEEP ALL YOU BUY

FOR GROWTH

line diagram of
the power system dur-
ing the transition period.



New feeders (black) will replace the old feeders (yellow)
and establish a simplified, modern distribution system.

GENERAL  ELECTRIC

321-42-5900


**LOAD-CENTER
POWER
DISTRIBUTION
SYSTEMS**

Which of these transformer assemblies will do the best job for you?

Standard
TRADE MARK

Rural transformers as manufactured by The STANDARD Transformer Company are not a cut and dried proposition. Builders of a full line of rural transformers, STANDARD installs "built-on" protective devices in a wide variety of arrangements to meet your requirements. And, a choice of accessories to meet your individual operating standards and requirements is also included in alternate tank designs which have two or four mounting brackets.

The AR, ARP, and CSP types are made in capacities of 1.5 KVA and up, in all standard voltage ratings.

NEW DEVELOPMENT

To meet the need for a small, low loss, and high efficiency transformer at low cost to handle small loads, STANDARD has developed a type called SRO. This new unit has ratings of 1 KVA for voltages up to 7620.

You will find upon further investigation that STANDARD'S transformers keep losses at a minimum and stimulate continuity of service. Therefore, write without further delay for bulletins S-301 and S-301-A.

THE STANDARD TRANSFORMER CO.

WARREN, OHIO

OFFICES IN PRINCIPAL CITIES

The STANDARD Transformer Co.
Warren, Ohio

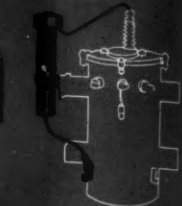
Please send Bulletin S-301-A on SRO type transformers and S-301 on AR, ARP, and CSP types.

Name _____
Company _____
Address _____
City _____ State _____

THE SPECIALISTS IN TRANSFORMER DESIGN FOR OVER 25 YEARS

FOR RURAL LINE SERVICE

TYPE AR



ARP with valve arrester

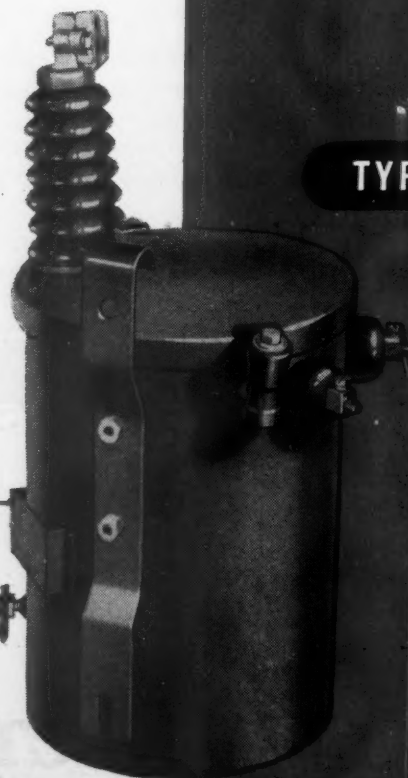


ARP with double gap arrester

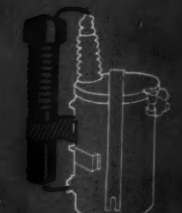


CSP single bracket

TYPE SRO



SRO with double gap arrester



SRO with valve arrester

Any of the above can be furnished with single or double mounting brackets

SAME STRONG POINTS OF CONSTRUCTION

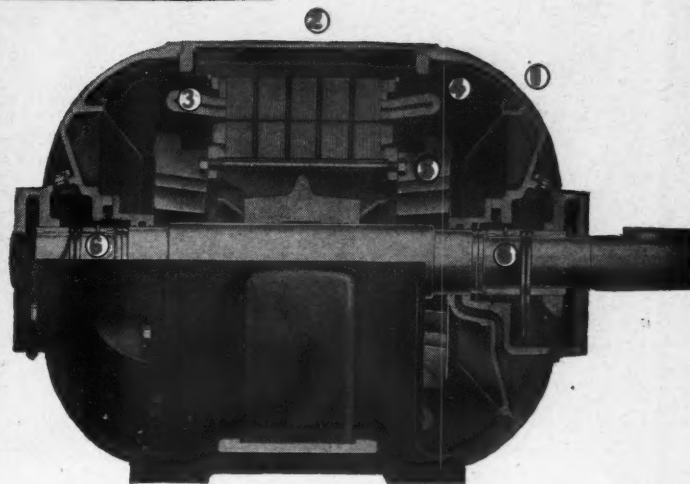
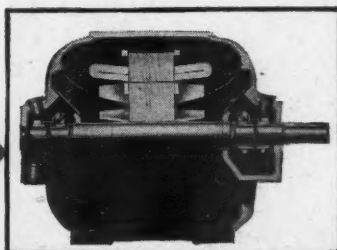
from 1 hp

to 2000 hp

Now all your drives — large and small — can have standard G-E Tri-Clad induction motors with the famous protective features that guard against **PHYSICAL DAMAGE, ELECTRICAL BREAKDOWN, OPERATING WEAR AND TEAR.**

Tri-Clad, in its wide range of types and sizes (recently increased to 2000 hp), is G.E.'s most widely used (integral-hp) motor. For complete details on ratings, characteristics, and dimensions, write for Bulletin GEA-3580. Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

HERE'S TODAY'S WIDER RANGE OF STANDARD SIZES	
Tri-Clad Type K (low starting current, normal starting torque)	1 hp to 2000 hp at 1800 rpm
Tri-Clad Type KG (high starting torque, low starting current)	5 hp to 200 hp at 1800 rpm
Tri-Clad Type KR (high starting torque, high slip)	Available to 100 hp in speeds required for high-slip flywheel drive (punch press, etc.)



- ① Cast-iron frame and rigid, cast-iron end shields protect the motor from external blows and accidental abuse.
- ② Completely enclosed upper portion of frame guards against entry of falling objects and dripping liquids; keeps chips and the like from vital motor parts.
- ③ Windings of Formex* wire—one of the toughest magnet wires yet developed—resist heat aging, heat shock, and abrasion.
- ④ End windings are coated with Glyptal* varnish, providing a tough, hard finish that withstands moisture, oil, and abrasion.
- ⑤ Low-velocity, double-end ventilating system keeps the motor running cool and prolongs insulation life. One-piece, cast-aluminum rotor (used on all but the largest sizes), with integrally cast fans, is practically indestructible.
- ⑥ Bearings have extra capacity to take heavy shaft loadings from any direction. Lubrication is convenient, its effectiveness well proved.

*Trade-mark reg. U. S. Pat. Off.

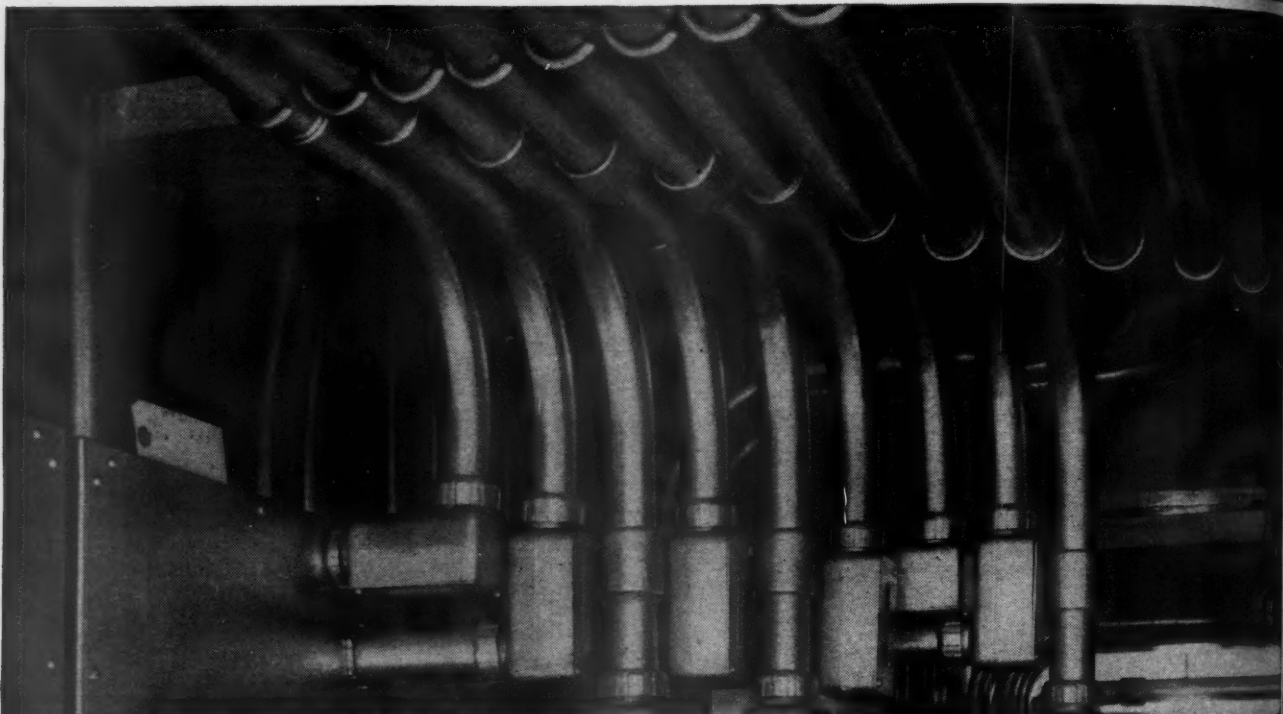
Buy all the BONDS you can — and keep all you buy

750-296-2090



GENERAL ELECTRIC

FOR SAFETY'S SAKE . . . USE CONDUIT (*Full Weight Rigid Steel*)



Smart Long-Term Planning Demands SAFE Wiring Methods

A double responsibility confronts the electrical industry:

1. The obligation to replace temporary, unsafe wiring systems, installed according to "must do" emergency ideas, forced on industry by shortages and regulations.
2. The duty to install only assuredly safe wiring systems in all new construction.

Remember this: The only wiring system approved by the National Electrical Code as moisture, vapor, dust and explosion proof in hazardous locations is a standard-threaded rigid conduit.

With standard-threaded rigid steel conduit, such as Youngstown's Buckeye, again available through distributors, there is no reason not to provide dependable wiring protection.

Wherever there is moisture, or vapor, or excessive vibration, or possibility of corrosion, or accumulating dust and dirt, or danger of crushing or other mechanical injury, specify and use Youngstown Buckeye Conduit.



YOUNGSTOWN

THE YOUNGSTOWN SHEET AND TUBE COMPANY

YOUNGSTOWN, OHIO

Manufacturers of

CARBON - ALLOY AND YOLOV STEELS

Ask your distributor for:

Youngstown Buckeye Conduit - Pipe and Tubular Products - Sheets - Plates - Electrolytic Tin Plate - Coke Tin Plate - Bars - Rods - Wire - Nails - Tie Plates and Splices

"3C" BULLETIN 5360 NON-REVERSING STARTERS give reliable DC MOTOR PROTECTION

For application to constant speed DC Shunt or Compound Wound DC Motors, or adjustable speed motors under 2 to 1 speed range, where jogging is not required and where starting periods are not more than 5 seconds out of each 80 seconds, this magnetic starter provides the following features:

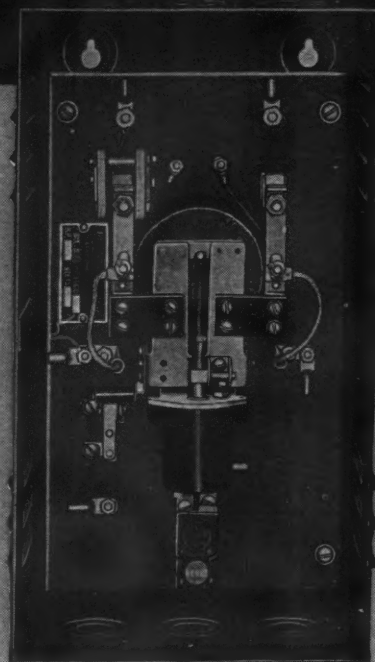
1. Time limit acceleration.
2. Ventwound resistor for effective heat dissipation.
3. Thermal Overload Relay—manual reset.
4. Single Coil operation.
5. Blowout and Arc shield on Line Contactor.
6. Renewable Forged Copper Contact Tips.
7. Arranged for 2 or 3 Wire Pilot devices.
8. Enclosed, Wall Mounted.

When the "Start" button is momentarily depressed, the operating coil is energized and main line contacts close immediately. Closing of the accelerating contacts is delayed on adjustable pre-determined time interval by a vacuum air dashpot. When accelerating contacts close, starting resistor is by-passed, putting the motor across-the-line.

When the "Stop" button is depressed, gravity and spring action of contacts force both main line and accelerating contacts open quickly—without retarding effect from the dashpot.

Write for descriptive Bulletin 5360.

The "3C" line is the ideal line
for Distributors to handle



OPEN VIEW



SIDE VIEW OF STARTER

THE CLARK CONTROLLER CO.

1146 EAST 152nd ST., CLEVELAND 10, OHIO • EVERYTHING UNDER CONTROL

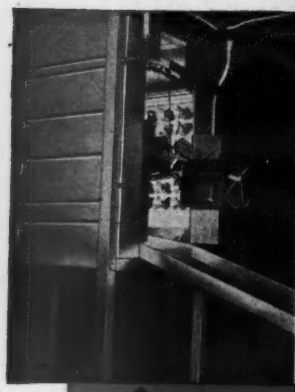


TRUMBULL

RAYMERSON INFRARED OVEN

... prefabricated

So Good
WE USE IT
OURSELVES!



Unfinished boxes enter drying oven (after leaving industrial washer) on way to dip tank or spray booth.

After paint dipping (or spray finish) boxes enter "Raymersion" Baking Oven.

Finished boxes now emerging from Raymersion Oven ... going to final assembly.

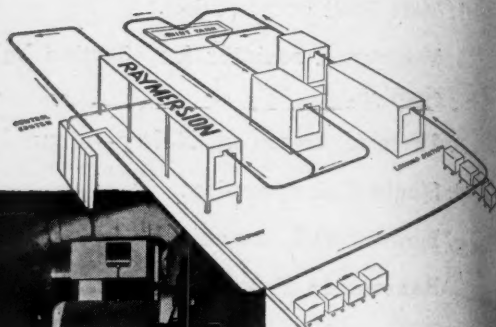
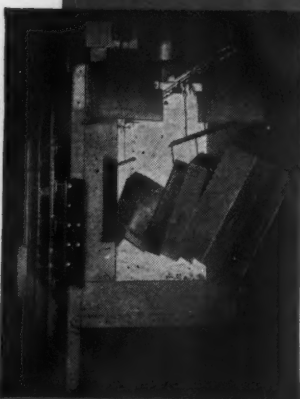
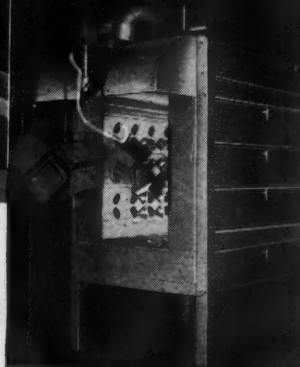


Diagram of Finishing Section showing route of switch boxes through wash, paint, paint dip (or spray booth) to "Raymersion" Infrared Baking Oven to final assembly.

Showing "Raymersion" Oven, Control Center and selective control system fed by (overhead) Trumbull Flex-A-Power run.

For the finishing section of Trumbull's Switch Box production line we are using our new "Raymersion" prefabricated Infrared Oven . . . just as you can use it in any type of Drying and Baking operation up to 500° F. . . for work of any size, shape or mass . . . in minimum time, at lowest cost. All oven components come to you ready for easy assembly, with associated Distribution and Circuit Control Apparatus . . . if required, all equipment for a 100% complete installation. Bulletin 500 on request.

THE TRUMBULL ELECTRIC MANUFACTURING CO.
PLAINVILLE, CONNECTICUT

OTHER FACTORIES AT

NORWOOD (CINN.) OHIO—LOS ANGELES—SAN FRANCISCO—SEATTLE



2272 MILES OF ELECTRIC CABLE FOR ONE FIGHTING LADY

NEWS FLASH—JUNE 13, 1945: "The new carrier *Franklin D. Roosevelt* will contain 2272 miles of electrical cable. She requires the services of 1,500 electricians while being readied for commission" . . . That's a hint of the Navy's enormous demand for wire and cable, much of it with VINYLITE plastic insulation. Non-flammable, this modern insulation greatly reduces the hazards of fire at sea. Beyond its high dielectric qualities it resists moisture, oils, abrasion, and most chemicals. Flexible at extremely low temperatures, and

virtually non-aging, VINYLITE plastics provide greatly improved conductor insulation and impervious sheaths for shipboard cable.

But ashore as well as afloat—to the public utility, industrial, automotive, and construction fields, and to aircraft applications—VINYLITE plastic insulation brings new measures of safety and service life. Its dielectric strength permits small diameter construction, and more conductors in existing conduits. It can be made in code colors for instant identification.

Covering the whole range from

portable cords to power cables, you can readily profit from the adoption of VINYLITE plastic insulation. Write Department today for Booklet W-4, "VINYLITE Plastics for Wire and Cable Insulation"—and we shall be glad to give you the names of suppliers.

BAKELITE CORPORATION

Unit of

Union Carbide and Carbon Corporation

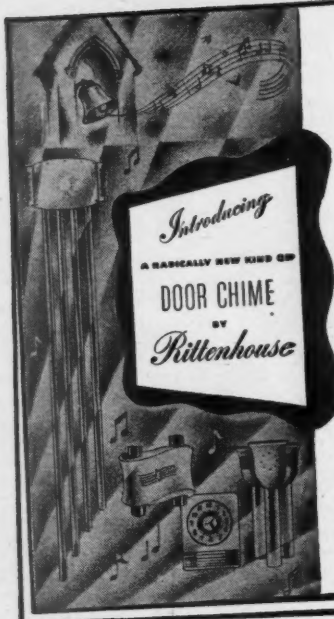
UCC

30 EAST 42ND ST., NEW YORK 17, N.Y.

Vinylite Plastics

TRADE-MARK

Electrical Contracting, December 1945



Write FOR YOUR COPY
OF THIS VALUABLE CHIMES
MERCHANDISING BROADSIDE
today!

★ Here's the ALL STAR RITTENHOUSE CHIME MERCHANDISING STORY...

RITTENHOUSE—top name in the electric door chime industry—has stepped on the starter! Production of those models which will have the widest and most immediate ready sale because of their design and price appeal is going ahead at full speed. Other models will be made available just as rapidly as maximum production effort permits.

Never before have electric door chime sales prospects reflected such glowing profit opportunities for electrical appliance wholesalers and dealers—in every community. And, timed perfectly to your sales efforts, millions are already seeing the strong, consumer-attracting Rittenhouse advertisements in leading National Magazines—and in big-circulation, key-city Sunday Newspaper Magazines.

In words and pictures, the Rittenhouse Broadside tells the story of a skillfully planned, up-to-the-minute merchandising program to make Rittenhouse Chimes the fastest selling, most profitable and appealing line of electric door chimes ever presented.

Expertly engineered to afford new mechanical features

that make possible undreamed-of tone richness and backed by the hardest hitting sales and advertising set-up in the history of chime merchandising, Rittenhouse gives you everything that makes for record sales and profits.

Send for this Rittenhouse Broadside now. Note the striking beauty of the ten new 1946 models styled by America's famous designer-stylist Norman Bel Geddes. Go over the important consumer-appealing Rittenhouse mechanical features. Weigh the sales power of the tremendous circulation, prestige-creating publications Rittenhouse is using to help you sell.

Join the Rittenhouse "Parade of Stars." Write us—TODAY.

See the Rittenhouse Chime Exhibit!

★ NATIONAL HOUSEWARES SHOW ★

Palmer House, Chicago

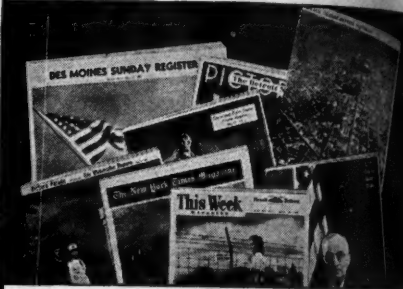
December 30th—January 4th

Rittenhouse America's Finest Chime Signals

THE A. E. RITTENHOUSE COMPANY, INC., HONEOYE FALLS, NEW YORK



NATIONAL MAGAZINES
... to tell the Rittenhouse Chime story to millions of America's consumers—wherever they live.



SUNDAY NEWSPAPERS
... advertisements in leading key-city Sunday Magazines—for immediate sales volume.



EXPERTLY DESIGNED DISPLAYS
... for sales-floor, window and counter use. Colorful, compelling and prospect-stoppers.



TRANSTATS

maintain voltages to a hairline
at GULF RESEARCH &
DEVELOPMENT COMPANY

Pilot Plant Control Panels, Gulf Research & Development Company, division of Gulf Oil Corporation, Pittsburgh, Penna. Transstat knobs are below ammeters.



111 TRANSTAT
A. C. VOLTAGE
REGULATORS
For 0.3 to 20 KVA.

In Gulf's Research Laboratories, unusual precautions are taken to eliminate variations. For example, fifty-six Transtat A. C. Voltage Regulators maintain required voltages to the heating elements inserted between pipe and insulation to compensate for heat lost. The extreme precision and ruggedness of Transtats results from the unique side-commutation. The long, cooler running brush rides on a glass-smooth track, providing arcless, stepless control. Bulletin 51-2 gives construction details. Write for it.



Showing Transtats mounted on rear of panel.

AMERTRAN

MANUFACTURING SINCE 1921 AT NEWARK, N. J.

Pioneer Manufacturers of Transformers, Reactors and Rectifiers for Electronics and Power Transmission



AMERICAN TRANSFORMER COMPANY
178 EMMET STREET, NEWARK 5, N. J.

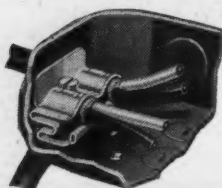


Say, Sonnyboy, WHERE KIN I FIND dis RACO?

• Raco is the famous name of All-Steel-Equip's quality line of steel switch boxes and outlet boxes. It's the dependable line, the uniform line, the line that's sold nationally through wholesalers only. Builders, Contractors and Architects the country over prefer Raco products. Here's why:

- Every product is a *precision product*—no jagged or rough edges, no dirt or grease. Smooth, attractive finish!
- Raco boxes come neatly packed in protective carton...with index showing number, quantity and finish. Easy to stock, inventory, and identify.
- All-Steel has been making quality metal products for over 33 years. The Raco line is made with the same care—to the same exacting standards!

Let us tell you more about Raco products... write today



DO-21-N-3 $3\frac{1}{2}$ " dia.
DO-16-N-3 4" dia.

Use Raco clamp type boxes to solve many of your connector worries.

DO-21-N-3, $3\frac{1}{2}$ " dia. is widely used with non-metallic cable.

DO-30-N, $3\frac{1}{2}$ " dia. is the perfect box for use with "BX."

ALL-STEEL-EQUIP COMPANY, INC.
600 Kensington Avenue, Aurora, Illinois

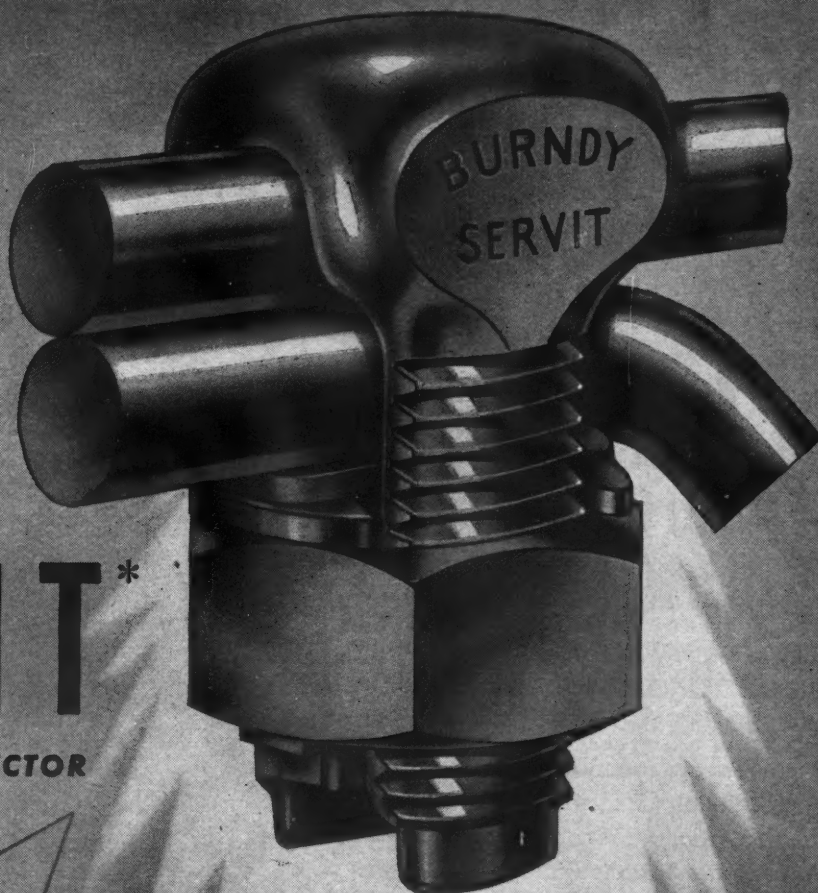


DO-30-N $3\frac{1}{2}$ " dia.
DO-31-N 4" dia.

RACO • ALL-STEEL • PRODUCTS
SWITCH BOXES • OUTLET BOXES

BURNDY SERVIT*

TYPE KS CONNECTOR



SERVICE CONNECTOR

The SERVIT is an outstanding favorite in the Burndy line of electrical connectors. Each Burndy connector is especially engineered for its specific job. Whether it's overhead or underground, indoors or out, Burndy connectors are easy to install . . . provide efficient, trouble-free connections. That's why it pays to "connect with Burndy". Literature, or engineering assistance on any connection problem is freely offered on request. Burndy Engineering Co., Inc., 107D, Bruckner Blvd., New York 54, N. Y.

* Registered Trade-mark

- ★ Forged for strength . . . from high-strength, high-copper alloy.
- ★ High pressure between conductors . . . proper selection of nut and bolt alloys reduces thread friction, increases effective pressure.
- ★ Extremely compact . . . a "natural" for taping.
- ★ Reusable . . . can be used over and over again; requires no special tools.
- ★ Takes more than 1 conductor size . . . 13 sizes of Servits accommodate wide range of conductors, from #10 to 1000 Mcm.

Headquarters for
CONNECTORS
Burndy

ILLINOIS PORCELAIN WIREHOLDER INSULATORS

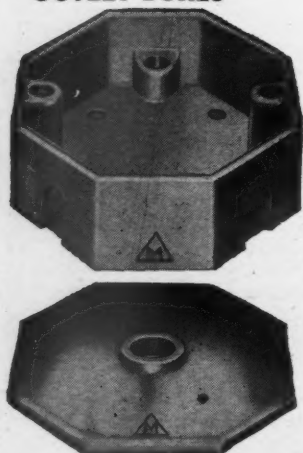
Insure
SAFE
HOUSE SERVICE
CONNECTIONS..

• When you use Wireholder Insulators with the name "ILLINOIS" you are backing up your work with the right quality for the job.

All corners are rounded to prevent injury to the insulation of the wires. The screws have deep, sharp threads for easy installation. The screws are fastened into the insulators with non-shrinking metal alloy. The all-steel screws are hot galvanized by a special process to insure a smooth, even coating. Will not cause rust streaks on the sides of buildings. These dry process wireholders are made in sufficient styles and sizes to meet all requirements. Wet process porcelain supplied on special order.



OUTLET BOXES



Glazed and unglazed styles conforming to all existing standards of dimensions, spacing, position of knockout holes, and mounting screws. High mechanical and electrical efficiency.

ALL-PORCELAIN ILLINOIS SYSTEMS *for*

*outstanding, adequate and
modern wiring jobs*



SWITCH BOXES

Insure greater safety in wiring and the elimination of all grounding hazards. Made of the best quality of white porcelain. Metal inserts are placed in two holes of the switch boxes for receiving screws of standard switches, plug outlets, etc. Knockouts for single wires, also for cables. Specify and use them.



KNOBES

Cement coated — extra length nail — genuine leather washer — code standard. They don't chip when driven in and they do stay in place and have a firm grip. Available in a wide variety of heights, diameters, holes, and grooves.

STANDARD TUBES

in sizes 1/2 to 48 inches long, 5/16 to 3 inches diameter in following types: unglazed, glazed, split, floor, split floor, headless, curved and, crossover split, and cross over. Diameters all uniform both inside and outside.

ILLINOIS ELECTRIC PORCELAIN COMPANY Macomb, Illinois



A GOOD START ON THAT WIRING JOB....

with a WURDACK PANELBOARD



Wurdack apartment and store building service entrance switch, fused feeder distribution board, with provision for socket type meters on face of cabinet.

Whether you're wiring a residence, an office building, a school, automobile sales and service agency, industrial plant, hospital, or a theatre—there's a Wurdack Panelboard that meets the most exacting job specifications and Underwriter's requirements.

Wurdack Panelboards afford the distribution system great flexibility and ease of installation, coupled with adequate carrying capacity and safety type, dead front construction.

Panelboards can be supplied with single or double fusing, with either plug or cartridge fuse connections, in addition to 30 amp. tumbler switches. They are supplied in standard catalog designs and special designs tailored to fit the specific requirements of the job.

Send for your copy of the
New Wurdack Fusible Panelboard Catalog

WM. WURDACK ELECTRIC MFG. CO.

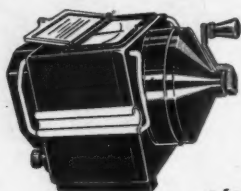
4444 CLAYTON AVENUE

SAINT LOUIS 10, MO.

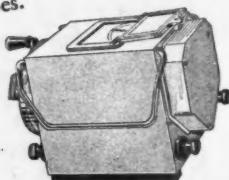
1946

Roll Call!

Specialized testing instruments and equipment . . . for rehabilitation, maintenance and special investigations . . . rugged and dependable . . . direct-reading and simple. . . We offer our literature, our personal assistance and our instrument specialties for the solution of your testing problems.



For Insulation Resistance. "Megger" Insulation Testers—Hand driven, Motor driven, "Meg," "Bridge-Meg," "Super-Meg" and Midget Types.
Catalog 1685-EC



For Ground Resistance. "Megger" and "Meg" Ground Testers.
Catalog 1645-EC



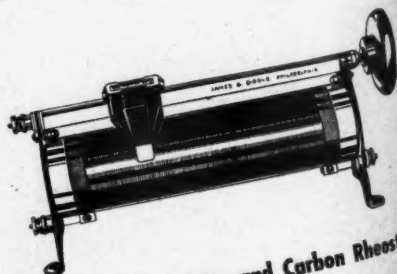
For Conductor Resistance. "Ducter" Low Resistance Ohmmeters—down to .000001 ohm.
Bulletin 1635-EC
"Megger" Ohmmeters—up to 1000 megohms.
Bulletin 1540-EC
Midget "Megger" Circuit Testing Ohmmeters—0.1-200,000 ohms.
Bulletin 1495-EC



To Measure Speed, Frequency and Rates of Vibration. "Frahm" Vibrating Reed Frequency Meters.
Bulletin 1770-EC
"Frahm" Vibrating Reed Tachometers and Vibration Indicators.
Bulletin 1590-EC



"Jagabi" Precision Tachometers, Centrifugal and Chronometric Types for Hand use.
Bulletins 1790-EC and 1800-EC



"Jagabi" Slide Wire and Carbon Rheostats. Wide variety of types and ratings.
Bulletin 1745-EC

JAMES G. BIDDLE CO. • 1211-13 ARCH STREET PHILADELPHIA 7, PA.

Out of the Ruins of Coventry

...an EFFICIENT INDUSTRIAL PLANT

FA BUSDUCT system makes war plant suitable for speedy conversion.

Here is a story that starts with a bombing raid on the English town of Coventry. In the merciless attacks that twisted schools, churches and industrial buildings into heaps of rubble, a vital shell producing plant was seriously damaged.

Much of the plant's equipment was shipped to an American city where a medium sized building was hastily built to produce shells of special size.

Now the plant is quiet, its occupant ready to resume the production of agricultural equipment. And here's the important part, the big point we want to illustrate:

- The removal of unwanted machinery
- The addition of new equipment
- The rearrangement of present machines

can be accomplished economically, speedily, and conveniently because Frank Adam BUSDUCT makes adequate power instantly available over every foot of the production area.



3000 amperes, 440 volt High Efficiency Feeder **FA** BUSDUCT system with 400 amp., 600 amp., and three 800 amp. **FA** SHUTLBRAK Tap-off switches.

If you are planning a new building, rearranging your plant layout, or converting to peacetime production, it's almost certain that you could profitably use Frank Adam BUSDUCT. Small plants, as well as large ones can save on equipment and operating expense with this modern method of power distribution.

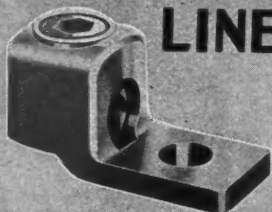
Write for the name of our nearest Representative—he has an interesting story to tell you.



Power Distribution Specialists for 54 Years
Box 357 St. Louis, Mo.



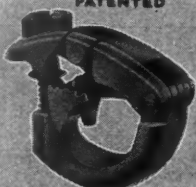
The Famous T&B LOCK-TITE LINE



LOCK-TITE LUG



LOCK-TITE
TEE-PARALLEL TAP
PATENTED



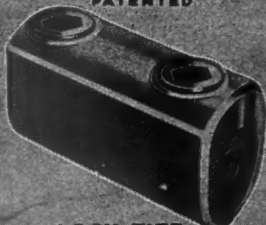
HINSON-JUNIOR
TEE PARALLEL TAP
PATENTED



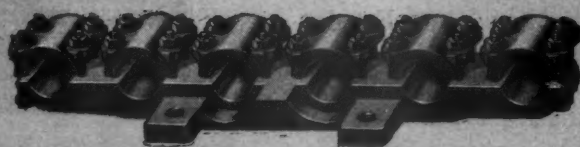
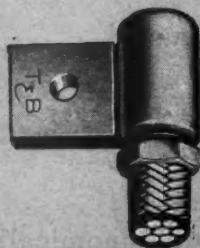
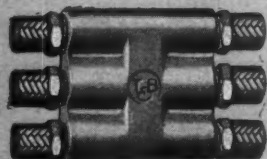
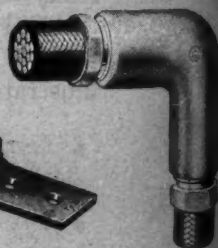
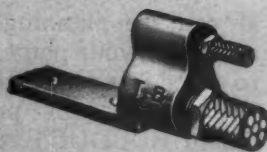
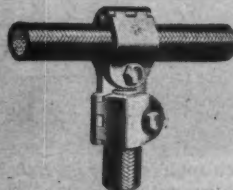
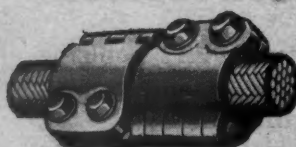
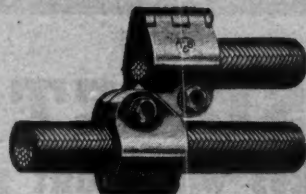
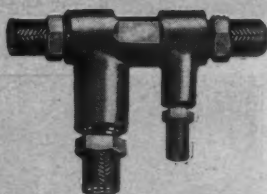
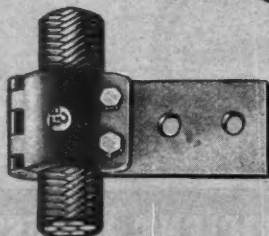
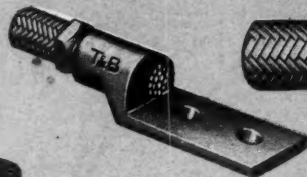
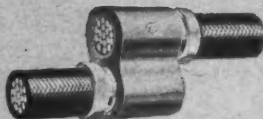
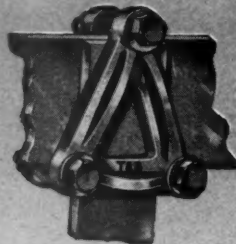
P.C. PARALLEL
CONNECTOR



LUG-IT STAMPED
COPPER TERMINAL
PATENTED



LOCK-TITE
TWO-WAY CONNECTOR



Available again

To Refresh Your Memory

AS YOU run your eye over these T&B Solderless Fittings, you can spot many of your old standbys and several war-born newcomers. They are part of complete T&B lines now available for all your wiring requirements.

With reconversion and new construction coming up, it is worth remembering that T&B modern Solderless Fittings install fast and stay fast.

They eliminate installing hazards, make perfect mechanical and electrical connections, and carry the endorsement of Governmental authorities and Underwriters Laboratories Approvals.

If you run into any particularly tough wiring jobs, our fast moving and resourceful Engineering Department will be glad to study them and design special fittings for you. Meantime, write for your copy of T&B illustrated Solderless Fittings Bulletin EC-2.

All T&B products are distributed solely through the service organizations of T&B Electrical Supply Wholesalers.



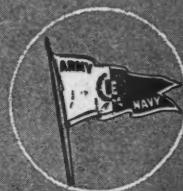
THE THOMAS & BETTS CO.

INCORPORATED

manufacturers of electrical fittings since 1898

ELIZABETH, N. J. NEW JERSEY

In Canada: Thomas & Betts Ltd., Montreal



Designed for
BETTER EFFICIENCY • BETTER LIGHT • EASY MAINTENANCE



All-bright

P R E S E N T S

THE ULTRA IN FLUORESCENT LIGHTING

All the elements of modern design, high efficiency and low maintenance costs have been incorporated in these high quality fixtures. They are constructed to give high intensity illumination with minimum glare and offer the most outstanding selling features you have been looking for in many a year.

Our research department has designed the "Skylight" fixture illustrated to achieve 10 to 20 more feet candle than any other fixture known of similar design. The "Skylight" offers an attractive skylight effect for easier seeing that helps to conserve vision and prevents eye strain. Fixtures can be mounted either individual or continuous row, flush or suspension mounting.

All-bright



... write for FREE Catalog for full
Build a better business
details.

TELEPHONE, JUNIPER 6024

ELECTRIC PRODUCTS COMPANY

MANUFACTURERS OF FLUORESCENT LIGHTING FIXTURES

3917 25 NORTH KEDZIE AVENUE CHICAGO 18, ILLINOIS

For Blowing..

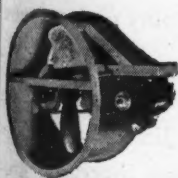
CHELSEA VENTILATING COOLERS

..for Exhausting!

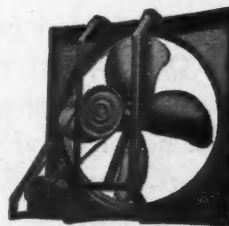
.. in meeting INDUSTRY'S needs!

CHELSEA fans and blowers—standardized for economy, diversified for suitability—meet all industrial requirements. Included are exhausters-ventilators for welding operations, pressure blowers for general purposes, fans for localized ventilation, louvers, roof ventilators, hood exhausters, equalizers, etc., for every phase of industry.

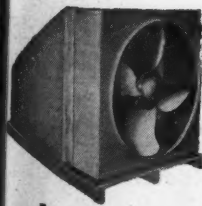
By specifying CHELSEA ventilating products for immediate or post-war office, plant or home installation, you are assured of quiet, efficient, dependable equipment. Backed by over 30 years' experience in specialized fan and blower manufacture. Details and product descriptions on request—write today.



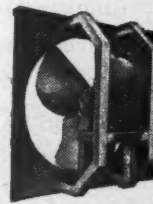
A



C



B



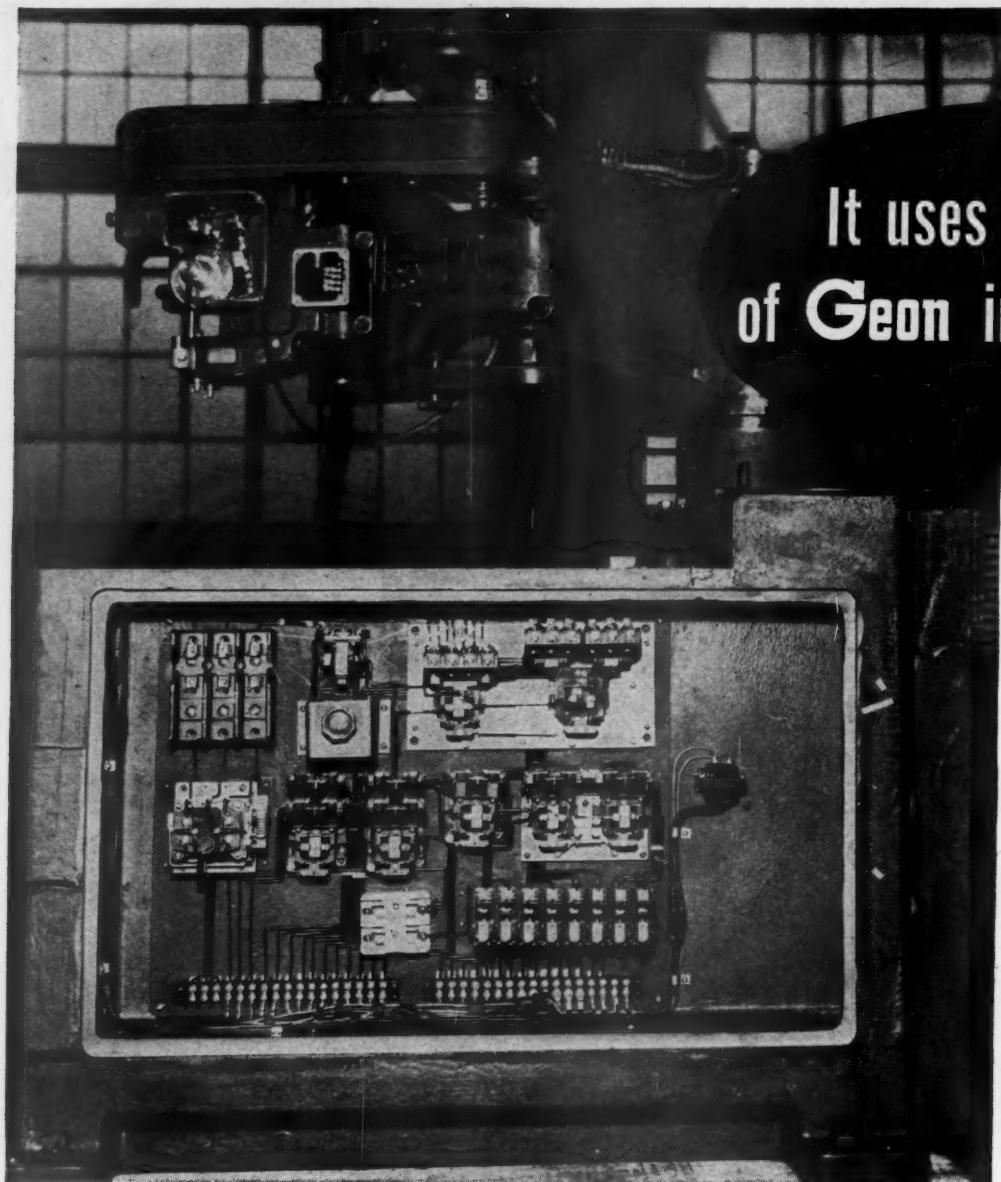
D

CHELSEA
PRODUCTS

INCORPORATED
1206 GROVE STREET
IRVINGTON, NEW JERSEY

(A)—TYPE D X B
SPRAY BOOTH EXHAUSTER
(B)—TYPE EU
PACKAGE ATTIC FAN UNIT

(C)—TYPE ED
GENERAL PURPOSE ATTIC FAN
(D)—TYPE BB
ALL-PURPOSE INDUSTRIAL FAN



It uses 1900 feet
of Geon insulated wire

THE picture shows you part of the 1900 feet of electrical wire that go into this *modern* tapping machine—*modern*, to give one reason, because every inch of the wire insulation is made from one of the GEON polyvinyl materials.

GEON is used because, in addition to possessing unusual electrical properties, it resists oil and oil fumes. It resists flame—is, in fact, self-extinguishing. It resists the heat of service conditions. It's smooth—permits easy handling and installation. It can be brilliantly colored in the entire NEMA range for easy, positive identification.

Because of GEON'S outstanding electrical properties, the coating of insulation can be much thinner—more conductors

can be run in each conduit. GEON is waterproof, acidproof, airproof, wearproof. It can be made into "spaghetti" to slip on fine radio or switchboard wire. Or it can be extruded onto heavy-duty underground power cable.

Right now all the GEONS are subject to allocation by the War Production Board. But limited quantities can be had for experiment. And soon, increased production will permit much broader use of these important materials. Meanwhile, our development staff and laboratory facilities are available to help you work

out any special problems or applications. For more complete information write Department YY-12, B. F. Goodrich Chemical Company, Rose Bldg., Cleveland 15, Ohio.



B. F. Goodrich Chemical Company

A DIVISION OF
THE B. F. GOODRICH COMPANY

GARCY STRIP

FLUORESCENT

WIRED AND ASSEMBLED

*Saves
Installation Cost!*



NO. 8000

IT'S HANDY!

Precision
Engineered
for Perfection
and Economy
on the job!

It's better in the long run . . . and in short runs too. 18 inches or 18 miles, the unique construction and quality features of **GARCY FLUORESCENT STRIP** insure perfectly true alignment, quick, inexpensive installation, and a permanently, trouble-free job. Check the features listed here and remember to . . .

Ask your jobber for
**GARCY FLUORESCENT
STRIP LIGHTING**

CHECK THESE GARCY FEATURES

1. Removable splice boxes and covers for each end. Splice chamber is 1½" long.
2. Couplings for connecting strips in continuous lengths. Extend 2" into each channel.
3. Embossed Screwholes in ends of strip match similarly embossed holes in couplings and end boxes. Strips are aligned perfectly straight, bringing sockets back to back.
4. Metal Socket covers prevent end sockets being bent backwards allowing lamps to fall . . . protect sockets from breakage in handling and lamping.
5. Rolled Edge channels and covers. Covers can be snapped on and off without screws.
6. Wire Leads. Covers are furnished assembled with ballast and sockets completely wired with 2 feet of extra wire lead at each end.
7. Heavy Gauge Metal. GARCY STRIP is rolled from heavier gauge metals. This combined with rolled and beaded construction provides a solid, substantial strip which does not distort or lose its shape.
8. Labels. GARCY STRIP is Underwriters' approved and Union wired.

GARCY strip lighting is also available for 2, 3 or 4 rows of lamps.

Reflectors, symmetric or asymmetric, are available for easy attachment to GARCY fluorescent strip.

Since
1898

GARDEN CITY PLATING & MFG., INC.

OGDEN BLVD. and S. TALMAN AVE. • CHICAGO 8, ILL.

New York Office — 600 Broadway

FOR HOT LOCATIONS

PERFORMITE

INSULATION WITH A

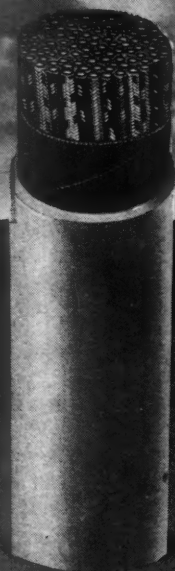
PERFORMITE
TYPE RH

CODE GRADE
TYPE K

PAST . . . In service for 14 years

PRESENT . . . Long service life

FUTURE . . . Provides for expansion



SIGNAL
CABLES



BRANCH
CIRCUITS

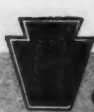


FEEDER
CIRCUITS

HOW MANY OF THESE PERFORMITE POINTS are of special value to YOU?

1. Safely carries 33 1/3% to 50% more current
Recommended for **REWIRING JOBS** where increased capacity is required
NEW INSTALLATIONS where future reserve capacity is desired
HOT LOCATIONS (copper temperature limitation 75° C.)
2. Super-aging
Resistance to heat and aging increases length of life far beyond ordinary rubber insulations
3. Non-corrosive Performite does not attack copper conductors
4. High Tensile strength and elasticity of insulation
5. Free-stripping saves installation time

Performite meets Underwriters' Laboratories requirements for Type RH Building Wire, ASTM Specs. D-754 for heat resisting insulation, IMSA Specs. for Municipal Signal Cables and many commercial specifications. Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.



HAZARD



insulated wires and cables for every electrical use

You Can Become A Charter Member of the Best Informed Audience in the World . . .

A FACT!!

An exciting new world is in the making — out of the developments of science — before our

very eyes.

A DEMAND!!

Every thinking American wants to know **HOW** these amazing achievements

will shape the pattern of his present and future life.

A PROMISE!!

Starting in

April, 1946, McGraw-Hill will publish a thrilling new non-technical general magazine that

will interpret, month by month, the impact of the scientists' world-shaping as it happens.

MEET A NEW AND DIFFERENT MAGAZINE



The job that **SCIENCE ILLUSTRATED** has set for itself has never been done before.

The need for such a magazine has long existed but the demand was never as pressing . . . the American public was never as inquisitive minded . . . as science-hungry . . . as deeply conscious of impending changes in our social and economic life as it is today.

SCIENCE ILLUSTRATED will cover the broad fields of science, invention, mechanics and discovery. It will discuss the new challenges and opportunities that are coming out of radar, the heady secret of the atom, and the amazing, world shaking advancements in communication and transportation.

It will interpret, for the progressive thinking layman as well as for the business man, the great new triumphs in drugs, medicines, chemicals, metallurgy, textiles, fabrics, food processes, materials, methods, procedures — the entire range of scientific achievement — in terms of their contribution to better living.

SCIENCE ILLUSTRATED will report, interpret, and project! It will be fast and fascinating reading —

a thrilling new magazine for an exciting new world! In its pages, month after month, the products, developments, and horizons of scientific achievement will come alive in terse, sparkling text and dramatic colorful pictures.

The subjects discussed in **SCIENCE ILLUSTRATED** will be of vital importance to everyone in every walk of life. No matter where your interests lie — in the products and processes of business or in the things which make for better and more efficient living — you will read this new magazine with profit, and with interest.

**If you would like to keep abreast
of the world of tomorrow
make your reservation NOW
for the first twelve issues of**

Science
ILLUSTRATED

A McGraw-Hill Publication



Experience Plus "Know-How" Will Produce

Science ILLUSTRATED

A McGraw-Hill Publication



DR. GERALD WENDT

Editorial Director: Editor, scientist, author, lecturer—most recently, full time science consultant for Time-Life . . . New York World's Fair Director of Science and Education . . . a practical, working scientist.



HARLEY W. MAGEE

Editor: Newspaper reporter, staff writer and, at one time, city editor for Associated Press in Chicago . . . formerly managing editor of Popular Mechanics . . . a writer with long experience in interpreting science for the lay reader.



DEXTER MASTERS

Editorial Consultant: Editor of Army Air Forces magazine, "Radar" . . . formerly staff member Radiatron Laboratory Massachusetts Institute of Technology . . . formerly member of Fortune's Editorial Staff . . . first editor of Tide.

To bring you this month by month reporting of progress and achievement McGraw-Hill has assembled the finest talent available. Working hand in hand with the men pictured here is a top-flight staff of science writers, artists and photographers . . . men with long experience in making science *understandable and interesting*.

In addition, the editors of **SCIENCE ILLUSTRATED**

will have at their command the great technical, consulting, research, and world-wide news gathering facilities of the McGraw-Hill Publishing Company. 196 editors, writers and technical experts, which staff the McGraw-Hill publications, will serve as consultants. All of McGraw-Hill's publishing experiences and financial resources are behind this thrilling new magazine.

N.B. to Advertisers: What kind of an audience will be available to you in **SCIENCE ILLUSTRATED**? Obviously, an alert, intelligent, forward thinking group of people . . . the sort of people that are a step ahead of the parade in interests, desires and purchasing power. The initial print order will be 500,000 copies. Forms close on February 10th for the April issue. Write to **SCIENCE ILLUSTRATED** or telephone your nearest McGraw-Hill office for complete information.

FIRST ISSUE ON THE NEWS-STANDS APRIL, 1946

Price per copy 25 cents. Annual Subscription . . . \$3.00 Per Year

Science Illustrated
330 West 42nd Street
New York 18, New York

Yes—I want to become a charter member of the best informed audience in the world. Enclosed is my check (or money order) for \$3.00. Please send me the first 12 issues of **SCIENCE ILLUSTRATED**—starting in April, 1946.

Name

Street and number

City and State

*Use this
Coupon*

housecleaning recommended



Remove temperature-raising "dust" overcoats for top performance of breakers and switches

◀ AVOID THIS . . .

Too much dust is accumulated on these switches and starters. Dust forms a heat-insulating "overcoat" which prevents normal heat radiation and raises operating temperature.

Westinghouse Recommends These Steps when Inspecting Safety Switches

1. Make sure disconnect ahead of switch is open.
2. Clean contacts, and check for alignment and proper pressure on hinge and break jaws. Apply light coat of sludge-free lubricant.
3. Remove and clean fuse contacts with fine sandpaper; check fuse ratings; tighten fuse contacts.
4. Clean switch base and insulating parts.
5. Make certain cable connections and lugs are tight.
6. Check switch for smooth operation and clearance of arc extinguisher, safety shields, etc. Lubricate operating mechanism.
7. Keep cabinets clean and free from rust—and keep covers closed.



Westinghouse
PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

In the urgency of war production, inspection and cleaning of vital controls, such as enclosed breakers and safety switches, may have been overlooked. Because these are vital links in your plant power distribution system, Westinghouse recommends periodic inspection and "housecleaning".

Benefits are manifold: reduced maintenance, higher operating efficiency and safety standards, protected investment, and not least . . . increased production.

Safety switches and Type AB-I circuit breakers are only two items of the Westinghouse complete line of standardized control. For any control, call your Westinghouse office, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-60605

AB-I BREAKERS AND SAFETY SWITCHES

RCA Sound Systems



RCA makes Sound Equipment for industry, office and all types of commercial buildings; for hotels, hospitals, schools and other institutions; for churches, theatres and stadiums—for installation wherever sound amplification or intercommunication is needed, either indoors or outdoors.

The expert engineering skill that develops RCA's outstanding radio, television and other electronic

products contributes to the design and manufacture of RCA Sound Equipment. No matter what type of building or alteration you are planning, RCA has Sound Equipment to suit your requirements. If you need assistance with your project, an RCA Sound Specialist is at your service. Send for free booklet: "RCA Sound Systems." Write: Dept. 70-142B, Sound Equipment Section, Radio Corporation of America, Camden, N. J.

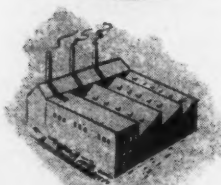
RCA SOUND SYSTEMS



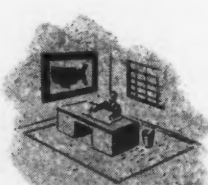
RADIO CORPORATION OF AMERICA

RCA VICTOR DIVISION • CAMDEN, N. J.

LEADS THE WAY . . In Radio . . Television . . Tubes . . Phonographs . . Records . . Electronics



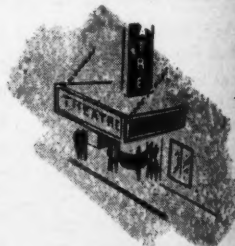
INDUSTRY



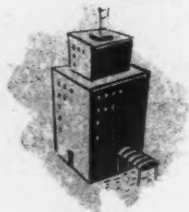
OFFICES



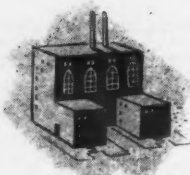
STORES



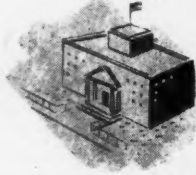
THEATRES



HOTELS



HOSPITALS



SCHOOLS



CHURCHES

70-4100-101

SHERARDUCT

ECONOMY

ECONOMY

XDUCT JR.

III XTENSIONDUCT—2 WIRES

III METAL MOLDING—4 WIRES

III METAL MOLDING—10 WIRES

"PLUG-IN" STRIP

FLORDUCT

SURFACEDUCT

4 X 4 WIREWAY

BUSWAY

NEPCODUCT

In post-war building and remodeling, critical customers will look for electrical products of the highest quality and best performance. They will expect the promises of a great, new electrical age to be fulfilled. Contractors, their licensed craftsmen and electrical engineers who rely on the National Electric System of raceways, wires and cables will more than fulfill these expectations. And the user will find in National Electric products greater serviceability, longer life, and precise adaptability to specific requirements.

Conduits
Surface Raceways
Wires and Cables
for every purpose

National Electric
PRODUCTS CORPORATION
Pittsburgh, Pa.

CONTROLLED ATOMS or CONTROLLED LIVES

SINCE August 6th when the first atomic bomb was released over Hiroshima, the American people have been subjected to a continuous barrage of pronouncements on the use and control of atomic energy. Some of this comment has been strident, and much of it conflicting. A considerable portion of it has been of sincere and constructive excellence.

It has not been easy to separate the wise counsel from the merely noisy, and it is small wonder that the minds of many are troubled and confused.

However, the sheer mass of discussion poured into press and microphone has awakened us all to the gravity of the issue. In terms of any problem on which Americans ever have been called to exercise a judgment—This is It!

Even the dullest now recognizes that atomic weapons hang over modern civilization like the Sword of Damocles, and understands in some measure how fragile and taut is the hair of political balance that holds it suspended.

From this point on, we need the coolest and most carefully considered judgment that can be brought to bear. Discussion highly charged with emotionalism will but increase the tensions both at home and abroad, and render wholly insoluble a delicately intricate problem.

What Is The Problem?

The major outlines of that problem now are coming into focus in understandable terms:

1. The scientists have opened up a new and virtually unlimited storehouse of energy, and the engineers have discovered how to turn it into a military explosive incomparably more powerful than any we have known. We know that this energy may also be used to produce heat for useful power, and we suspect that the radioactive substances produced by the process in hitherto unimagined quantity may also have medical, industrial, and other constructive applications.

2. Terrifying as have been the demonstrations of the atomic bomb thus far, we know that they are as nothing in comparison with its potential destructiveness. The explosive force of individual bombs can be increased tremendously, and means for their effective delivery to predetermined targets in wholesale quantity already are at hand. The experts tell us that no practicable means of interception can be devised, and that reprisal in kind probably will be the only answer to an enemy attack with atomic weapons.

3. So far as we can see now, even successful retaliation would be at best an answer of hollow effect. Any two nations each having wholesale stock-piles of bombs could accomplish the practical destruction of each other.

Since a first treacherous blow might well constitute an enormous advantage, a nation actuated by a ruthless urge to conquest or revenge might have the best chance of survival. But since the widest possible dispersal of bombs and launching units would be dictated by the strategy of atomic weapons, it is doubtful that one nation could destroy another without itself suffering destruction. On both sides the major centers of population could be wiped out, and the nation of least concentrated industrialization and commerce would suffer least. However, no one can be sure that the concentrated explosion of as many as 20 thousand atomic bombs would not poison the atmosphere of the world to an extent that would be fatal to great masses of population, not only within the country bombarded, but perhaps in the country which launched them.

4. The problem is further complicated because, so far as we know now, any large-scale commercial use of atomic energy as a power source is more or less inextricably linked to a potential military use. It is true that, if atomic power becomes economically feasible (which is by no means certain for a long time to come), it would require only low-grade concentrates of fissionable material, which would need further elaborate and costly processing before reaching explosive potential. But the process of producing such low-grade concentrates constitutes perhaps two-thirds of the industrial effort required to make effective bombs. It follows, then, that if nations were to equip themselves to produce large quantities of low-grade concentrates for power generation, the effort required to develop large-scale bomb production would be materially reduced. Moreover, the maintenance of an effective inspection to police agreements not to produce bombs might be forbiddingly difficult if atomic power generation were allowed.

5. In addition to the major problem posed by the use of atomic bombs in international war, any nation which produces or possesses such bombs, or the fissionable materials with which they are loaded, faces still another in the danger of their falling under the control of paranoid elements in its own population.

What Are We Going To Do About It?

We face the hard fact that we have produced a weapon capable of destroying whole nations—perhaps even the whole world. Although we were importantly aided in its development by the nationals of other countries, we, together with Great Britain and Canada, now must take the initiative in deciding what shall be done with it. We have only two choices. We can try to keep this weapon as a monopoly of our own, or we can try to place it under broad international control.

Can We Keep It To Ourselves?

If we know one certain fact about the atomic bomb, it is that it cannot long be held as a monopoly of those nations which produced it.

If Nazi Germany had succeeded in developing the weapon first, it probably would have attempted to achieve world dominion, with utter destruction as an alternative. Such a course is not within our range of choice. It violates every principle for which we stand.

Much reckless nonsense has been uttered concerning the inability of other nations to master the scientific, engineering, and industrial problems involved. It is the virtually unanimous opinion of those who worked on the project that several nations today are fully equipped in science, engineering, and industrial organization to produce atomic bombs and to provide the means for launching them. At least one of these nations, Russia, has also access to an ample supply of the necessary raw materials. The only debate is over whether it would take three, or five, or ten years for her to marshal her resources to produce bombs in multiple thousands. Once such an atomic race were on, we have no reason to believe that Russia might not divert more resources to the task than we ourselves should be willing to put into it.

Additional nonsense is talked as to how we might attempt to cope with the problem of living in a world in which mutually suspicious or hostile nations faced each other, with stores of atomic weapons on both sides. We hear talk of dispersing our cities and even of moving underground. No one has seriously reckoned the difficulty or the cost of following such counsel of despair. Still less has anyone appraised the neurotic effect upon men's minds of living by any such preposterous formula, under continuously mounting tension day after day, and year after year.

Certainly, if we could find no way to prevent the competitive production of atomic weapons, we should be driven at least to the selective dispersion of our bomb-launching facilities, of certain key industrial establishments, and of our centers of government and governing personnel. We should be forced, also, to change our traditional requirement that only Congress can commit us to active war. We should be forced to organize ourselves as a police or military state, with our scientists regimented and muzzled, with all of us under constant surveillance against the smuggling and planting of time-bombs, and constantly alerted against attack through the air.

Before we commit ourselves to any such intolerable procedure, we should be mad not to explore all possible means for making it unnecessary.

The Only Feasible Alternative Is Effective International Control

This cardinal principle has been recognized in the statement of November 15th, issued jointly by President Truman, and Prime Ministers Attlee and King. Their statement frankly concedes that against atomic weapons there can be no adequate military defense, that no nation can command a monopoly of such weapons, that responsibility for eliminating atomic energy as an instrument of war and for devising safeguards over its use for the

advancement of science and other peaceful and humanitarian ends rests upon the civilized nations of the world.

They propose that a commission be set up at once under the United Nations Organization to make recommendations: (a) for extending between all nations the exchange of basic scientific information for peaceful ends, (b) for control of atomic energy to the extent necessary to ensure its use only for peaceful purposes, (c) for the elimination from national armaments of atomic weapons and of all other major weapons adaptable to mass destruction, and (d) for effective safeguards by way of inspection and other means to protect complying states against the hazards of violations and evasions.

Already criticism is leveled at the wording of the statement, at alleged omissions, at the wisdom of choosing the United Nations Organization as the medium through which to seek agreement in view of the weaknesses of the UNO Charter.

None of these issues should be crucially important. What matters is that an invitation has been issued in good faith for the nations of the world to meet and decide upon means for assuring the elimination of weapons, the existence of which no one can afford to tolerate.

The decision cannot be other than international; it will require the best thought of the best brains the world can muster. The smaller nations have an equal stake with the large, and from them may well come the most fruitful suggestions. But Russia now holds the key to the success or failure of our proposal. If she accepts our invitation, no other nation will refuse.

Alternatively, there will be an international armament race paced by atomic weapons. It will mean an end of free science, a severe policing and regimentation of international travel and trade, and innumerable restrictions upon those individual freedoms which we have just fought so desperately to preserve. This is the dismal prospect if we fail to arrive at a genuinely international accord on the control of atomic energy. But even this interval would promise to last only for an uneasy period, until someone started pressing the push-buttons on the panel-boards of extinction.

The only permanent solution lies in finding means to eliminate war itself. That we cannot hope to achieve overnight, but we can, and do hope that the nations will now agree to eliminate atomic weapons and their radioactive by-products as instruments of war.

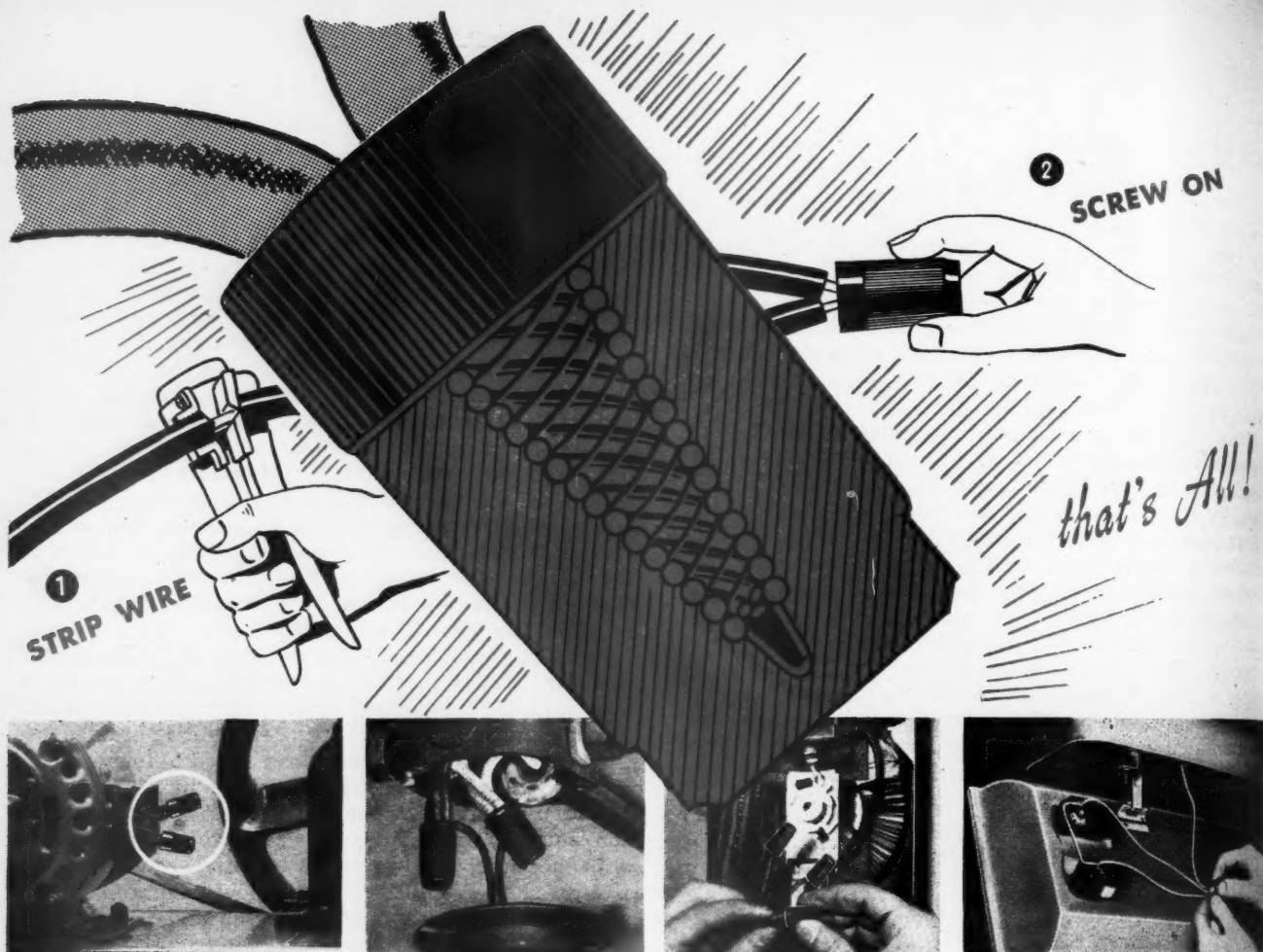
If they do that, we can move forward more surely to the constructive development of the incalculably valuable resources that science has newly opened to our use. And, we can hope also for a progressive improvement in international understanding.

Unless the nations can reach agreement on this paramount issue of atomic energy, it is difficult to conceive of any vital issue on which they might agree.



President, McGraw-Hill Publishing Co., Inc.

THIS IS THE 42ND OF A SERIES



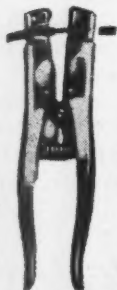
Cut Wiring Costs with IDEAL "WIRE-NUTS"

New Low Prices

IDEAL "E-Z" WIRE STRIPPERS

Strip fast!—Clamp, cut insulation and strip with one gentle squeeze of the handles. Do a neat, quick job—do not cut the wire. Cutting edges are shielded to protect hands. Blades replaceable.

Two models, "Standard" and "Automatic" for stripping both solid and stranded wires. 4 sizes for No. 30 to No. 8 gauge.



"Automatic" Model

PROMPT DELIVERY

WRITE FOR FREE MOTOR MAINTENANCE HANDBOOK

IDEAL HAS THE MOST COMPLETE LINE OF MOTOR DRIVEN, HAND AND FOOT-OPERATED WIRE STRIPPERS ON THE MARKET.

OTHER WIRING DEVICES

Lugs, solder and solderless • Split Bolt Connectors • Fish Tape, Reels and Pullers • Joist Boring Machine • Cable and Wire Reel • Test Lights

Now, in addition to making wire joints that are better electrically—stronger mechanically, you get the extra advantage of *new low prices*. You can't afford to use old-fashioned methods when this safer, better and faster way simplifies the work of wiring new circuits, making plant changes, relocating and installing machinery, etc. IDEAL "Wire-Nuts" (solderless, tapeless wire connectors) make permanent trouble-free wire joints without fuss or without solder and tape.

Easy to use—simply strip wires, screw on, that's all! Recognized as standard throughout the Electrical Industry. Fully approved by Underwriters' Laboratories, Inc.

Free samples on request.

Electrical Products Division
IDEAL COMMUTATOR DRESSER COMPANY
1041 PARK AVE., SYCAMORE, ILL.

IDEAL *Sycamore*

Sales offices in Principal Cities • Consult your Local Telephone Book
In Canada: IRVING SMITH, Ltd., Montreal, Quebec

DECEMBER at a Glance

The cover picture this month illustrates an insulation test set-up on a large Westinghouse motor, symbolic of the vast job of industrial reconversion in progress throughout American industry. Speeding industrial reconversion is still one of the top most jobs in the electrical industry.



NECA's first postwar meeting in Cleveland last month previewed many strong and sound plans for meeting problems in the days ahead. Particularly important were the programs which are being developed around cooperation of labor and sound public relations for the electrical construction industry. And a constantly recurring theme throughout the meeting was a new realization of the importance of contractor leadership in the affairs of the electrical industry. In this issue we are presenting a complete report of the Cleveland meeting, together with abstracts from some of the important and significant papers. The story begins on page 45.



Slimlines, the new, long, narrow fluorescent lamps, are due to make history in lighting. The first large-scale application of slimline lamps in a modern commercial installation has just been completed in St. Louis. You will find the story on page 57. It has been described in considerable detail because it is not only an unusual application of lighting techniques, but typical of a kind of functional lighting that will find its way into many commercial establishments in the coming months. And it's clearly typical of the kind of lighting market that lies ahead.



Electronic controls need not be elaborate or complicated to be useful. In a Chicago bearing com-

pany, close tolerances and automatic operation were developed with relatively simple vacuum tube control units. The methods applied can be adapted to many industrial operations. You will find the story "Tolerance Control Through Electronic Timers" on page 62.



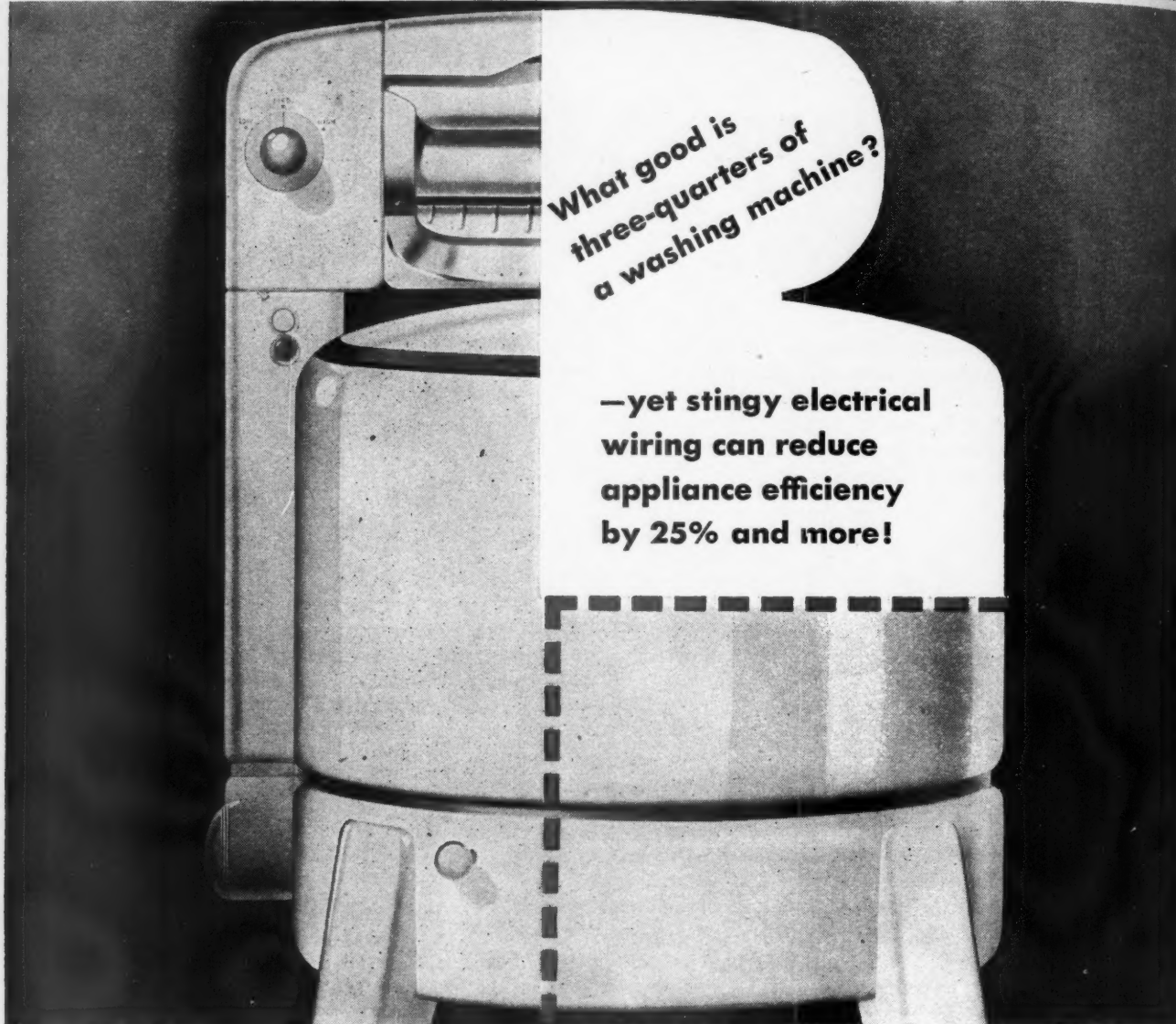
Among the outstanding papers presented at the NECA meeting in Cleveland was George Andrae's discussion of the 1946 National Electrical Code. While present predictions indicate late 1946 as the earliest we can expect to see the new revision, the changes contemplated are of prime importance to everyone concerned with electrical installations. Andrae's preview, "What's in the 46 Code" will be found on page 54.



This month we begin another series of articles in the Industrial Electrification section. The subject is high frequency heating. The author is Dr. H. B. Osborne, Jr., Director of Research of the Ohio Crankshaft Company, Cleveland, Ohio. This article explores the fundamental principles and theory of high frequency heating. Both induction and dielectric heating promise to play an increasingly important part in industrial processing. This series of articles gives a sound knowledge of the fundamentals and the practical application of these processes for electrical men.



Much of the maintenance problem on commutators revolves around proper brush tension. On page 71, D. E. Stafford of the National Electrical Coil Company in Columbus, Ohio describes how to set up proper spring compression for different brush materials. A good know-how article.



What good is
three-quarters of
a washing machine?

—yet stingy electrical
wiring can reduce
appliance efficiency
by 25% and more!

-Wire ahead

Anywhere from 25% to 50%! That's what you can lose in service from appliances when electrical wiring is inadequate.

Have you checked up on the wiring for *your* postwar electrified home? Will it carry electric range, refrigerator, laundry equipment, garbage disposer, exhaust fan? How about the many other appliances—plus, perhaps, advanced heating, air-conditioning and, of course, television?

Plan your wiring now to get all the service you pay for in these living comforts. Make sure wiring is at least equal to future needs.

Business Executives! The same goes for *your* postwar plans. Don't limit production

with out-of-date wiring. Don't risk expensive alterations for emergency electrical expansion. It costs nothing now to check with consulting or plant power engineer, electrical contractor or power salesman. They'll say: Wire Ahead! Anaconda Wire & Cable Company, Subsidiary of Anaconda Copper Mining Company, General Offices: 25 Broadway,

New York City 4, Chicago Office: 20 North Wacker Drive 6, Sales Offices in Principal Cities.

**DON'T BE
PENNY-WISE
AND
POWER-
FOOLISH**

✓ *Check your wiring plans
before they check you!*

BUY VICTORY BONDS...
HELP ASSURE WORLD PEACE



ANACONDA WIRE & CABLE COMPANY

ERA OF CONTROL

When wiring systems are designed our attention is pretty much focused on the devices and apparatus which use or convert energy. The lamps, motors, heaters, rectifiers and welders are the primary elements in the job, and rightfully so, providing they do not dominate our thinking to the exclusion of effective control.

Control is becoming more and more an essential part of utilization. One of the simplest examples is the familiar electric iron, higher wattage plus an automatic thermostat and heat selector control gave us an appliance that was entirely new in convenience, usefulness and safety.

In illumination we are accustomed to using only the most elementary control methods. We provide switches to turn the lights in a room, office or factor bay on and off. Here is a fertile field for control application, for automatically controlled levels of illumination, for controls which provide a range of lighting intensity depending upon the needs or designs of the moment.

In homes especially we need better light control. Homemakers have long used a rudimentary scheme of light control by turning on more or fewer lamps. And one of the real barriers to good functional in-built lighting is the idea that it must be operated at full intensity or entirely off. A good control scheme can do as much for public acceptance of modern home lighting as any development in lamps and fixtures.

In heating and air conditioning, we have a great variety of excellent control devices which need only effective promotion and use to revolutionize our standard of living and comfort. In the months and years ahead we are going to see comfort controls of this type in almost universal use. And whether these are separate gadgets installed by electrical men or integral controls in the major equipment, we should promote and foster their use and application. Once the public accepts the convenience of easy electrical control in one device, they are all the more responsive to developments of control and automatic operation in other fields.

War production has greatly stimulated the development of control devices in industry. And thousands of returning service men have become familiar with the intricate but efficient controls which operate bombers, tanks and guns. The public is receptive to modern control ideas and, in fact, expects the electrical system of the future to include new convenience and plenty of automatic operation.

It's up to the electrical industry to put its imagination and skill to work—to meet the challenge of the new era of control.

Wm. J. Stuart

Electrical Contracting

DECEMBER, 1945

A MILLION WORDS CONCERNING CONTRACTORS

The ad below—which Graybar is running in *The Architectural Forum*—reminds architects and builders that you, as electrical-installation specialist, are familiar with latest developments in wiring, lighting, and all other electrical supplies. As such, the ad

emphasizes, you should be consulted early in the stages of building design—when your knowledge can be of real help in getting electrical details right. Graybar is ready with the right supplies and tools to help you carry out every job.

4591

*How soon
can you read a
million words?*



Do you have the time now — or ever — to read all the new printed matter that's being issued on all the new electric products for buildings? We venture that if you added up all the words in all the current catalogs, mailing pieces, and what-not, they'd total well into seven digits.

Yes, new developments in electric products and wiring techniques are coming thick and fast. It's quite a job for anyone to keep up with all of them.

JOHN WATTS
ELECTRICAL CONTRACTOR

CHECK ELECTRICAL DETAILS EARLY WITH

"John Watts" (any qualified electrical contractor) devotes all his time to the electrical side of building construction, so it's only natural that he's up to date on developments in wiring, lighting, signaling, power apparatus, and supplies. As installation specialist, he knows all the "angles" that may affect your plans. He's familiar with local codes and ordinances, labor conditions, product availability, installation costs.

So, when you check with John Watts early in the stages of design, you make sure that your electrical plans will be fully practicable. There's no more important factor in getting your projects completed on time.

You make sure, too, of getting the newest and best in everything electrical — because the "John Watts" everywhere obtain electrical supplies and tools via Graybar. Graybar Electric Co., Graybar Bldg., N. Y. 17, N. Y.



IN OVER 80 PRINCIPAL CITIES

THE ARCHITECTURAL FORUM, DECEMBER 1945

CLEVELAND, OHIO OCTOBER 29-31

NECA CONVENTION REPORT

The electrical construction and maintenance program ahead, its related activities, responsibilities and opportunities with labor, industry, government and the public outlined at the 44th Annual Meeting of the National Electrical Contractors Association, Cleveland, Ohio, October 29-31.

RELLEGATING the past five war years to their proper place in history, and looking into the future, the electrical contracting industry faces a building boom of unprecedented proportions, and an emergence into the realm of big business, the National Electrical Contractors Association concluded at its 44th Annual Meeting. Gathered at the Hotel Carter in Cleveland, nearly 400 delegates from all parts of the country discussed plans for meeting the tasks and opportunities ahead with representatives of industry and government in a crowded three-day program. The great advance of electrical development during the war years was recognized as setting the responsibility for some 1500 members of NECA of maintaining high standards of installation and service, and of participating to a greater extent in the distribution and sales programs of the entire electrical industry.

It was estimated that the job ahead involves about five times as much business for electrical contractors as that of their normal prewar level, and

about twice that of their wartime peak. To successfully meet their responsibility and participate fully in the program ahead requires drastic reorientation of industry-wide thinking and planning, with full cooperation with its labor source, the International Brotherhood of Electrical Workers, NECA spokesmen concluded.

Included in the agenda for the three day meeting were construction and business forecasts, discussions of business promotion and selling, distribution problems, public relations, the home building program, a report on the 1946 National Electrical Code, and a full session of the IBEW Employees Section Annual Meeting.

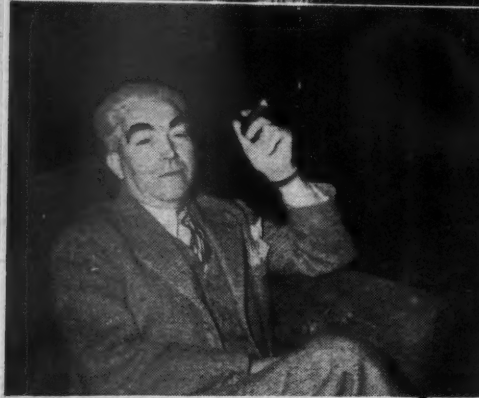
MONDAY, OCTOBER 29.

Robert W. McChesney, NECA President, keynoted the Annual Meeting in his opening address, "*The Road Ahead — NECA's Responsibilities.*" "We are assembled here in acknowledgment of our responsibility to the entire industry and to perfect our plans

for the necessary follow-through by our individual chapters and members," Mr. McChesney said.

After reviewing the part taken in the war program by the electrical contractor, he concluded that the electrical contracting industry emerged with the status of *big business*. He predicted a building boom unprecedented in history, which will demand the full business acumen and technological skill and know-how of the construction industry and mechanical trades, especially of the electrical industry. He also predicted a great advance in electrical development, involving new control and utilization devices which will require expert installation and skillful maintenance.

Because the electrical contracting industry is stepping into the realm of *big business*, it is necessary for NECA members to unite in a strong and aggressive organization formed on solid business lines, in order to protect the interests of electrical contractors and electrical workers, Mr. McChesney said. This requires increased budgets



(1) Frank E. Vogel, The Edward Electric Co.; and Wm. McGuineas, president, United Electrical Construction Co., both of Chicago. (2) Edward P. Fogarty, president, The Fogarty Electric Co., Cincinnati, Ohio. (3) Warren Penn, sec'y., Los Angeles Chapter, NECA; J. B. Shamel, Shamel Electric Co., Inc.; and A. L. Stone, Stone Electric Supply Co., Los Angeles. (4) L. T. Allen, Allen Electric Co., Tulsa, Okla.; George and Leo Camp, Camp Electric Co., St. Louis, Mo.; and Paul Wright, San Antonio, Texas. (5) E. C. Carlson, Carlson Electric Co., Youngstown, Ohio; and E. L. Moorehead, Moorehead Electric Co., Marion, Ind.

and a larger staff and field force, he said. He recommended the creation of an office of executive vice president and the addition of a technical research and statistics division to increase the effectiveness of the organization.

The NECA program for 1946 involves six major functions, Mr. McChesney said, and outlined them briefly as follows:

1. Organization and Management.
2. Field Service.
3. Public Relations.
4. Labor Relations.
5. Government Relations and Legislation.
6. Technical Research and Statistics.

Laurence W. Davis, NECA General Manager, presented his annual report on the membership and financial status of the Association. He pointed out

that although electrical contracting is now classed as *big business*, the NECA organization is not yet complete. There remain many essential activities which should be put into effect, he said, and these will require the full support of every member.

Membership has increased from 1134 in 1944 to 1439 at present, or an increase of 305 members during the past year, Mr. Davis revealed. An annual volume of business in excess of \$1,000,000 was reported individually by 24 members during 1945, he said.

Reporting on Field Service activities, Paul M. Geary, Assistant General Manager and Field Director, NECA, posed four questions. His answers to these questions formed the basis for his report.

1. *What has been done since the 43rd Annual Meeting?* NECA members have been assisted with labor requirements, it was pointed out. Also, the interests of the electrical contractors have been protected in connection with the government Wage and Price Stabilization Program. In addition, NECA membership has been increased by approximately 30 percent, it was stated, and many disputes between members have been cleared up.

2. *Why hasn't more been done?* The point was made that lack of time for a limited staff has prevented greater accomplishment, and the fact that much effort is often required to obtain many of the objectives.

3. *What is planned for the coming*

CONSTRUCTION AHEAD...

By JOHN L. HAYNES, Chief, Construction Division, Department of Commerce

Construction activity in 1946 will approximate \$7 billion, a modest start on the expected \$15 billion volume by 1950. Attainment of this full construction goal is going to take a bit of doing on every one's part.

For one thing there is the necessity for industry cooperating to forestall inflated prices that would lead to a boom and bust situation. Another prime job is to reduce the cost of construction so that the low-income groups, who need housing the most acutely—can buy homes. The immediate job is to uncork the supply of building materials.

The industry must strive to give the consumer more for his dollar if we are to reach the construction goal of \$15 billion, and beyond. Some economies will automatically follow with an increase in volume—other reductions in cost should, and can, come via specific action. This is a job for the industry itself—for both labor and management—it is one of self-regulation. No single government agency can order this result. Participation by labor unions, Chambers of Commerce, building congresses, home builders associations and trade groups can be of inestimable help.

Four reasons that account for high construction costs are (1) seasonal variation in employment; (2) obsolete building codes; (3) restrictive agreements between labor and management; (4) unwarranted speculative profits.

In 1946 private construction will be for the first time in many years more than twice the amount of public construction. In 1946 the breakdown is: residential \$2 billion; industrial, \$1.1 billion; farm, \$400,000,000; utilities, \$800,000,000; other private, \$850,000,000; total private, \$52.2 billion, publicly-financed, \$2.07 billion which includes \$800,000,000 for roads. The 1945 volume on maintenance and repair is about \$4 billion.

BIG BUSINESS . . .

By R. W. McCHESNEY, President—NECA

There are two developments almost certain to come to pass: One, a building boom of unprecedented proportions demanding much more from the mechanical trades, especially on electrical work; and, Two, a great advance in electrical development, especially new control and utilization devices that require expert installation and skillful maintenance.

We are assembled here in acknowledgment of our responsibility to the entire industry and to perfect our plans for the necessary follow through by our individual chapters and members.

In recent years the industry has built a stupendous plant needed to prosecute the war and did so with unprecedented speed. War construction totaled approximately \$44 billion, about \$2.2 billion of which was electrical.

The fact of becoming big business became also a menace to the security of the electrical contractor. Many general contractors saw in this volume an opportunity for added profits to themselves if they could eliminate the electrical contractor. NECA had become a strong, effective organization with a field force covering the country in your interests, and the preference of the electrical worker to deal with electrical contractors, prevented the general contractors from taking over our business.

Vigilance must be maintained. NECA must be put on a fuller business basis with considerably increased budgets and added staff, including the position of executive vice president and a technical research and statistics division.

year? The objectives of the past year continue, it was stated, and every effort will be made to make NECA the type of contractor's organization its members have always wanted it to be. Further coordination of national and local activity is required, it was explained. Problems relating to government, labor, material still affect industry.

4. How can these things be done? NECA must have capable energetic representatives in all field organizations, said Mr. Geary. Anything which can be done to insure fair profits, and to provide full employment at all times, will contribute to the success of the Field Service program.

NECA Field Supervisor George A. Seaman of Ft. Worth, Texas, was introduced as one member of the Field Service staff who will assist in this program. Other members of this group introduced were NECA Division Representatives P. J. Lowry, Pittsburgh; Emil Preiss, New York; E. L. Sant-schi, Chicago; and Charles S. Thurber, Birmingham.

The NECA Legislative Committee report was presented to the convention by Alfred J. Hixon, Chairman of the Committee. This Committee recommended a standard form of license law. It also suggested that legislation be sought to further fair competition among bidders.

In presenting this report, Chairman Hixon gave a broad general background of the fundamental basis of law making, reviewing basic principles in some detail. He pointed out that there

exist hundreds of licensing laws, some State, others city, hardly any two of which are alike. Many of these are in disrepute. About half of the country has no licensing laws at all. Proposed standard form licensing laws generally have failed to pass, in Mr. Hixon's opinion, primarily because they have been too broad in scope and because of a lack of preparation and coordination of effort by all interested parties.

A proposed standard form of license law for State enactment was made a part of the report. It was recommended for adoption as a standard, as a guide to the fundamental requirements of such a law. It was recommended

(6) NECA officers W. Edward Frazer, Philadelphia, vice-president, Division 2; and president Robert W. McChesney, Washington, D. C. (7) F. C. Michael, Mill & Marine Electric, Inc., Gastonia, N. C.; DuPont Guerrey, Huntington & Guerrey, Inc., Greenville, S. C.; J. M. Richardson, Richardson-Wayland Electric Corp., Roanoke, Virginia. (8) George W. Patterson, Patterson Electric, Ltd., Toronto, Can., and D. B. Clayton, Electric Constructors, Inc., Birmingham, Ala. (9) J. A. Wolf, Enterprise Electric Co., Inc., Philadelphia; Wm. F. McCarter, Cates & Shepard, Philadelphia; Stan Cameron, H. P. Foley Co., Inc., Philadelphia; Alfred J. Hixon, Hixon Electric Co., Boston, Mass. (10) John L. Flagg, Watson-Flagg Engineering Co. and W. H. Robinson, Jr., Manager, Advertising Div., Lamp Dept., General Electric Co.





(11) Sam N. Peters, Peters Electric Co., H. E. Beall, H. E. Beall Electrical Construction; and Eddie Delany of Home Electric, all of Galveston, Tex. (12) Hank Flener, Chapel Electric Co., Jackson, Mich.; John E. Launder, Independent Electric Machinery Co., Kansas City,

Mo. (13) Andrew H. Stubbers, president IlSCO Copper Tube and Products Co., Cincinnati, O.; R. J. Heffernan, Louisville, Ky., member NECA Board of Governors; Paul Leary, Wadsworth Electric Mfg. Co., Covington, Kentucky. (14) S. C. Dodson, Dodson Engineering Co., Omaha, Neb.; and John W. Jenner, Shelly Electric Co., Wichita, Kansas.

for enactment and administration by State governments in the interests of efficiency and uniformity, it was stated.

Legislation has been, and is at the present time, being sought which will govern and improve bidding practices on public work, reported Mr. Hixon. Four important facts must be recognized by those proposing to secure such legislation, he stated, and these were outlined as follows:

1. Competitive bidding is absolutely the only way the public interests can be served free from fraud and favoritism.

2. Competitive bidding of necessity if not carefully regulated, leads to many evils before the letting of contracts, due to the basic selfish interests between general and sub-contractors.

3. The general contractor should not be allowed to let sub-contracts on any work on the basis of the price he will pay, without the advice and consent of the owner and his advisors—the architect and engineer.

4. The advantages of unit responsibility in the contractual relation between the owner and the general contractor is recognized as leading to efficiency and economy of operation on construction work, and no law should be passed taking this advantage away from the public.

The four principles outlined above were incorporated in a State Law passed in Massachusetts in 1939. A copy of this law formed a part of the Legislative Committee's report. "The Committee presents this law," said Mr. Hixon, "not as a universal panacea for the cure of all bidding practices, but as a definite step in advance along this line, and would recommend that either it be adopted in toto or revised as a model for similar legislation elsewhere, applying to either State or Federal Work."

Mr. Hixon further stated that

whereas the Massachusetts statute relates entirely to public work, the Legislative Committee feels that the procedure might well be used in connection with private work. The Massachusetts law is designed to curb *bid peddling*, which occurs before selection of the general contractor, and to curb *bid shopping*, which takes place after the selection of the general contractor, it was pointed out. *Bid shopping* consists of the general contractor holding further competition in his own interests, and is usually detrimental to the owner without the owner's knowledge, he explained.

John L. Haynes, Chief of the new Construction Division, U. S. Department of Commerce, and previously Director, Construction Bureau, WPB, forecast a \$7 billion construction activity in 1946. This activity should reach a going rate of \$15 billion annually by 1950, he predicted.

In 1946 private construction, for the

UNPRECEDENTED PROSPERITY . . .

By JOSEPH D. KENNAN, Vice Chairman, WPB

The electrical contracting industry stands on the threshold of unprecedented prosperity and opportunity to serve, and with its unmatched record of social-consciousness should be able to cope with the puzzling new problems of atomic power, prefabrication and electronics.

If the electrical contractors' war record is an example of what to expect, I know that the job will be done in a manner that will surprise even the most optimistic among us.

Industry expanding for peacetime production will require extensive electrical installations. Residential construction will become more and more an important part of the work of electrical contractors.

The present picture is indeed encouraging, but we must not forget that the time will come when the present pent-up demand for electrical appliances will be satisfied. The industry must seek to open up new fields and constantly improve its products. This means that prices must be kept low, and in line with actual cost. Labor has an equal responsibility with management.

The electrical contractor's goal should not be solely to get as much work as he can; but to do as much as he can at top efficiency. Good service, a good product, at a fair price is the best salesmanship for the contractor.

Thus far we have conquered atomic energy only for destructive uses. If the atomic age brings new and better services to the American public, in 20, or 50 years from now, I feel confident that the electric construction industry will approach the matter open-mindedly and with common purpose.

first time in many years, will more than double public construction, Mr. Haynes said. He gave the following breakdown for 1946 construction:

Residential	\$2.0 billion
Industrial	1.1 billion
Farm	.4 billion
Utilities	.8 billion
Other private	.85 billion
Total private	5.2 billion
Publicly financed	2.07 billion

The figure for publicly-financed construction includes \$800,000,000 for roads, Mr. Haynes stated.

Maintenance and repair work for 1945 will total about \$4 billion, which will tend to drop if corporate taxes are reduced, it was stated.

Industry must cooperate to forestall inflated prices which would lead to a "boom and bust" situation, Mr. Haynes pointed out, and to reduce construction costs to permit low-income groups to buy homes. "Recent polls," he said,

"show that the public will postpone building or buying if the price is more than they have in mind, and most buyers are thinking in terms of less than \$6,000." He stressed that industry must strive to give the consumer more for his dollar, if the construction goal of \$15 billion is to be reached. The industry itself, both labor and management, must do this job, through self-regulation, he said, and pointed out that labor unions, Chambers of Commerce, building congresses, home builders associations and trade groups can be of inestimable help. He cited four reasons for high construction costs:

1. Seasonal variation in employment.
2. Obsolete building codes.
3. Restrictive agreements between labor and management.
4. Unwarranted speculative profits.

Mr. Haynes indicated that an inadequate supply of building materials would retard construction until after the first quarter of 1946. Brick inventories are the lowest in 20 years,

he said, and while production is increasing, it is below demand. Production of cast iron pipe is extremely low and insufficient labor to do this work is caused by a low industry wage, it was indicated, and radiator and bathtub production is crippled by strikes. Military cutbacks have not affected building material production to any great extent, he further stated.

As Chairman of NECA's Business Promotion Committee, Lester F. Brooker, president, Brooker Engineering Company, Detroit, outlined the Committee's comprehensive and aggressive sales and promotion program for bringing to postwar America the advantages of the electrical industry's wartime developments and advances, and for increasing the contractors' role in this expanding economy.

"It is apparent that a broadening of our scope of sales activities is inevitable," Mr. Brooker said. "Many electrical contractors have voiced the opinion that the industry requires no sales effort other than the the every-day service rendered to customers." He

pointed out that the electrical contracting business and electrical developments is now a new enterprise. Competition will soon be resumed on a much larger scale, and new materials and advanced stages of engineering have developed a new era, he told the delegates. These changes demand new "Business Promotion" methods, wherein the individual contractor must do the actual selling job, he said.

Most electrical equipment, especially newly developed items, is complex and unsafe for any amateur to tamper with, and worthless unless properly installed, tested and serviced. That requires the services of a qualified electrical contractor, of which there are approximately 2000, all qualified engineering-sales firms, scattered throughout the country and ready to shoulder their responsibilities of distribution and qualified service, Mr. Brooker said. Other thousands of electrical contractors will be able to improve their service and meet this problem, thereby offering for the electrical contracting industry some 50,000 engineering salesmen to the electrical industry's retail distribution force.

"Only by intelligent, continuous and expert handling of business promotion by our membership can we hope to bring together the united services of this Association, and of labor, and thereby cope with this challenge," Mr. Brooker said. He reported that the NECA Business Promotion Committee proposed permanent employment of a public relations director who would direct NECA's sales and business promotion program, and introduced George B. Roscoe who has been appointed to this position. The recommendation included establishment of a national committee through which this program could be executed aggressively and with the full cooperation of each of NECA's 53 chapters.

PENSIONS . . .

By G. M. BUGNIAZET, Secretary-Treasurer IBEW

Care for workers in an industry is an industry matter, not a matter for workers alone. Proper disposition of social welfare matters is good business for employers in that workers who may look ahead to security in old age will have a loyalty that will pay employers in the end. They will also be better buyers of manufactured products.

Good relationships between employers and workers is paramount in any social welfare plan. The IBEW and NECA have had a long record of good relations. Social security for wage earners, through the Social Security Act of 1933 provides minimum coverage only, and should be supplemented by industry effort.

The present IBEW plan now provides that every member reaching 65 years of age, with 20 years good standing in the union may be retired with \$40.00 per month pension, plus certain other benefits. Assessments upon individual members, set up in 1928, are at very low rates, too low for actuarial accuracy. We invited the officers of NECA to discuss the resulting problems with a committee from IBEW's International Executive Council. An agreement was reached upon a plan which is now being submitted to NECA membership.

Where business is competitive, it is not easy to supplement social security coverage. It must be made by the entire industry. This goal is complicated by the fact that there are many employers involved.

(15) F. A. Weible, F. A. Weible Co., Dover, Ohio; C. F. Hammer, sec'y-treas., Toledo Electrical Contractors Assn.; and W. N. Brown, president of the Toledo contractor group. (16) Morris Newmark, Morris Newmark & Brother, Philadelphia; and E. T. Vanderlinde, Vanderlinde Electric Corp., Rochester, N. Y. (17) International officers of IBEW at NECA convention were G. M. Bugniazet, secretary; E. J.

Brown, president; and Gordon M. Freeman, vice-president, fourth division, Chattanooga, Tenn. (18) Charles H. Stark, president, Stark Electric Co., Baltimore, Md.; Lloyd K. Zinn, vice-president, Howard P. Foley Co., Harrisburg, Pa.



COOPERATION . . .

E. J. BROWN, PRESIDENT

International Brotherhood of Electrical Workers

Let us achieve President Truman's economic objectives by developing a wider application of labor and management cooperation between each local union and local chapter of NECA, a pattern of cooperation which has grown for a generation. There have been no serious strikes in this industry for 25 years.

Let us go forward and do a good job—through collective bargaining and through labor-management cooperation.

We are an organization which cooperates with its employer—because we are thinking about the same things; how to make this industry better and how better we can serve the public.

We cooperate because it is the best way to serve the public. Though we may be criticized for working together, I know of no better way to do our job than by such cooperation.

An example of effective labor-management cooperation was the building of the huge atomic bomb plants at Pasco, Washington and at Clinton, Tennessee. We were asked to confer with the then Under Secretary of War Robert P. Patterson when the job was being planned. He wanted 5,000 electricians. We told him that there was only one way to get them and that was through cooperation with the electrical contractor. NECA was called into the conference and we went to work to staff those plants. Electrical workers on other less important work throughout the nation were called in and the plants built on schedule. As a result of this cooperative effort, both the union and the association received commendations for a job well done.



(19) H. L. Miller, *Utilities Engineering Co., Philadelphia*; and A. H. Wilson, *Electrical Construction Co., Inc., Washington, D. C.* (20) C. S. Thurber, *NECA Division 3 field representative, Birmingham, Ala.*; W. C. Bryant, *manager, Dallas, Texas Chapter, NECA.* (21) H. F. Fischbach, *Fischbach & Moore, Inc., New York*; S. C. Sachs, *S. C. Sachs Co., St. Louis, Mo.*; W. J. Howe, *J. Livingston & Co., Chicago.* (22) Andrew D. Smith, *Ypsilanti, Mich.*; E. L. Santschi, *Chicago, NECA*

George B. Roscoe, recently appointed NECA Director of Public Relations, described the role of the Public Relations program for the electrical contracting industry as one dedicated to better serving the public welfare. He said that a vigorous and effective business promotion program is an important part of that role. "Public welfare can best be served by doing everything possible to raise the American standard of living" he said. "Electrical contractors are going to carve out a bigger place for themselves in this Industry's distribution pattern because they can do the job better, more economically and more satisfactorily than anybody else" he continued.

Mr. Roscoe outlined the Public Relations' immediate program through nine points, including: promotion of

business and development of sales; establishment of better relations with other branches of the electrical industry and the construction industry; support of codes and standards for higher technical, safety and service standards; promotion of good labor relations and good human relations; support of NECA-IBEW apprentice training program; maintenance of close contact with government.

Amendments to the NECA Constitution were approved by vote, the primary function of which was to set up duties for an Executive Vice President, to be appointed by the Administrative Committee. This action is in line with the goal set by President Robert W. McChesney to transfer many of the duties of the President to the new office of Executive Vice Presi-

dent, which will help to establish the office of President as an honorary office.

Other actions included relaxation in the Constitution on time for holding annual meetings, and changing of detail work previously assigned to Board of Governors to the Administrative Committee. A new section 10 was added to Article XI which permits the Administrative Committee, at its discretion, to establish a pension fund for retiring paid officers who are retired after reaching the age of 65.

The Rural Electrification Administration is, in effect, upholding discriminatory and chiseling tactics against electrical contractors, Col. O. R. McGuire, NECA's General Counsel, reported. Electrical contractors from all parts of the country, and particularly in the Midwest, have reported attempts by REA, and its co-operatives, to negotiate lower prices



Div. 4 representative; and Joseph D. Keenan, Vice Chairman for Labor Production, WPB, Washington, D. C. (23) J. J. Williams, *Lord Electric Co., Pittsburgh, Pa.* (24) R. A. Goeller, *Hatzel & Buehler, Inc., New York City*; Charles J. Schwab, *Buffalo Electric Co., Buffalo.*

after bids have been received and publicly opened. Many have reported discrimination by REA on the grounds that the contractor has or is doing work for a competing private utility, Col. McGuire said.

These conditions were first called to the attention of REA Administrator Claude Wickard, who upheld REA's policy, Col. McGuire revealed by reading a letter signed by Mr. Wickard, which stated, "The very substantial conflict of interests which results in the situation where a contractor performs work for the utility company and the borrower in a competitive area, is sufficient justification for the borrower's not accepting the contractor's bid." This matter has since been referred to the Secretary of Agriculture and to committees in Congress, Col.

McGuire said. They are: the Senate and House Committees on Appropriations, the Senate and House Small Business Committees, and the House Interstate Commerce Committee.

NECA members, other electrical contractors, and their friends were urged to bring this situation sharply to the attention of Congress, and to refuse further bids to any co-op without prior assurance that there will be no chiseling.

TUESDAY, OCTOBER 30

One of the problems affecting the entire electrical industry, that of electrical distribution, was introduced by S. C. Sachs, Chairman of NECA's Inter-Industry Committee, in opening the second day's session of the Annual Meeting. In submitting that Committee's annual report, he stressed the importance of team-work within the electrical industry, if maximum bene-

effective performance as an efficient distributor of electrical materials and equipment, as well as providing a qualified installation service, Mr. Sachs pointed out. Also, they must see that, once having established their reputation as engineer-salesman-retailers, they play the game fairly and squarely. This, he said, is a matter of voluntary industry regulation.

Dependence on government for working out and policing inter-industry relations must be discarded, Mr. Sachs stated, and said "Our remedy lies within our own exercise of industrial democracy." To carry out this program, NECA is organizing local Inter-Industry Committees to promote better understanding between contractors, wholesalers, manufacturers and utilities in each community.

Changes in the 1940 National Electrical Code which will be incorporated

in the 1946 publication of the Code were reviewed by George Andrae, Chairman, NECA Codes and Standards Committee.

Meeting in Chicago in early October, the Electrical Committee of the National Fire Protection Association faced a greater task than usual, Mr. Andrae said, due to issuance of many wartime amendments, to the introduction of many subjects never before covered in the Code, and to the complete re-writing of the text of several Articles.

Among new subjects to be covered in the Code are Electric Welders in a separate Article, fluorescent lighting fixtures in Article 410, machine tool wiring in a new Article 670, infra-red heating in Articles 210 and 422, high capacity industrial network systems, remote control, low energy power and signal circuits in a new article 725,



(25) Jack G. Krider, sec'y-mgr., Illinois Chapter, NECA, Peoria, Ill.; Lyle Foster, Peoria, president of the Chapter; and A. C. Skon, Eiseman & Skon, Chicago. (26) Ralph E. Darby, Appleton Electric Co., Chicago; Leo J. Witt, Witt Electric Company, Youngs-

town, Ohio. (27) J. D. Beltzhoover and C. M. Beltzhoover, Beltzhoover Electric Co., Cincinnati, Ohio; and J. Walter Collins, secretary, Electrical Contractors Association of City of Chicago. (28) Efram A. Kahn, Jamaica, N. Y., president, New York Electrical Contractors Association; and S. J. O'Brien, S. J. O'Brien Sales Corp., New York City. (29) H. Williams, I.B.E.W. Local 212 business agent, Cincinnati, and John O'Connell, Hatfield Electric Company of Cincinnati.

PROMOTE BUSINESS...

By L. F. BROOKER, President, Brooker Engineering Co., Detroit

Many members of the electrical contracting industry have voiced the opinion that the industry requires no sales effort other than the every-day service rendered to the customer. No opinion can be further from the truth.

The minds of contractors have been trained upon the practical side of performing the work, at the expense of training in the art of getting business. Any promotion plan that would relieve the contractor from individually soliciting business would fail, however. The actual selling job must eventually be done by the individual contractor.

Our business is comprised of a relatively small number of large contractors and a large number of small contractors. The smaller contractor being most numerous and in many cases most active in his personal solicitation of customers, is frequently assumed by the public to be truly representative of the industry. There is a decided lack of knowledge that electrical contracting is "big business" and conducted as such.

We must seek recognition by business and industry that ours is a complex profession which cannot be carried on by untrained minds and inexperienced forces. We must seek recognition by manufacturers and wholesalers of the potential market and sales force made available by confining distribution to our vigorous, organized branch of industry.

We must seek recognition by authorities of the need for control of a profession with which rests the responsibility for safety of life and property.

fits are to be achieved from postwar electrical distribution. "The electrical industry should draw about the biggest gate receipts in postwar America," he said, "because it has more to offer that is new, labor-saving and enjoyable," but cautioned that its success will be measured by team work.

Pointing out that the electrical industry team comprises the utilities, manufacturers, wholesalers, and contractors, he emphasized that contractors must shoulder the full load and responsibility in sales effort to merit their share in profits. "We feel that we can make the consumer's life much fuller by the wide and intelligent use of electricity, a job which demands the full attention of all members of the team," he said.

Electrical contractors must make certain their approach to jobs includes

(30) Paul M. Geary, assistant general manager, NECA, Washington, D. C.; and Harry W. Kellams, manager, Washington, D. C. Chapter, NECA. (31) S. P. Lipkins, Broadway Maintenance Co., New York City; L. D. Kennedy, secretary, Greater City Electrical Contractors Association, New York City.



LEGISLATION . . .

By ALFRED J. HIXON

Two types of legislation affect all electrical contractors:

1. The general laws such as Anti-Trust, Fair Trade Practice, Social Security, and various revenue laws.
2. Special laws which apply to the electric trade or to contracting. Such laws are licensing, registration, inspection, etc.

The subject of licensing electrical contractors and electrical workers has been, and is, a subject upon which legislation has been sought from time to time. There are a great many laws and ordinances in effect in the United States, hardly any two of which are alike; some being State laws and many being City ordinances. It is safe to say that fifty percent of the country as a whole, has no licensing law at all.

In the interests of efficiency and uniformity we think that all licensing laws should be enacted and administered by State governments, since any smaller governmental sub-division leads to confusion in form and requirement, and in most cases, failure of administration.

Any attempt at licensing which does not include both elements of the construction industry, namely, the employer and the employee, is not effective in accomplishing the fundamental purpose of licensing, namely, the protection of the public against loss of life or property.

We suggest the following procedure to enact legislation:

1. Cooperation and agreement of organized labor and the inspection interests.
2. Full publicity to early activities among all interested parties, such as general contractors, manufacturers, central stations, etc.
3. Have it presented by a political leader who is a statesman and believes in it.
4. Delegate a committee who will actively follow it through all stages of legislation and prevent it from getting side-tracked.

and many others. Mr. Andrae's convention paper is presented in full on page 54.

The Home Building Program, which was established in 1940-1 and dropped during the war is destined to reach \$100 billion dollars in the next ten years, Warren Penn, Manager, Los Angeles Chapter of NECA told the meeting. The building construction industry now accounts for the second largest annual income, and approximates twelve percent of the national income, he said.

New community planning, with connecting super highways is necessary and home builders must put their business on a production basis, if the goal set is to be reached, Mr. Penn stated. Lack of lumber may retard the home building program temporarily, he said.

A new Handbook of Interior Wiring Design will be released by year's end, E. A. Brand, Chairman of the Industry Committee on Interior Wiring Design told NECA delegates. This committee is composed of representatives from all branches of the electrical industry.

The handbook is a booklet on how to "plan" wiring, and does not relate to installation, nor to types of mate-



(35) A. C. Prange, General Electric Supply Corp., Bridgeport, Conn.; Eugene Ashe, Eugene Ashe Electric Co., Fort Worth, Texas. (36) Ohioans Jerry Strickler, Hatfield Electric Co., Cleveland; G. O. Tucker, city electrician, Lorain; and S. J. Bickley, city electrician and inspector, Sandusky. (37) T. L. Rosenberg, T. L. Rosenberg Co., Oakland, Calif.; L. E. Mayer, Hyland Electrical Supply Company, Chicago. (38) Wm. S. Fell, treasurer; E. R. Leonard, vice-president; W. W. Clark, president, The Dingle-Clark Co.; and A. J. Pickett, sec'y-mgr. of the Greater Cleveland Chapter, NECA. (39) H. C. Evans, Evans Electrical Construction Co., Inc., Kansas City, Mo., with J. N. St. Clair of his staff; and J. E. Collier, Collier Electric Co., Denver, Colo.

(40) Walk
ing C
son,
lyn, N
Produ
M. D
New Y
chapt
A. I. L
tric C
NECA
Rosen
Louis
Inc.,
Eden
Nashv
manag
Spoka



(32) H. E. Dozer, National Electric Products Co., Cleveland; and Wm. C. Schlosser, Capital Electric Construction Co., Madison, Wis. (33) K. D. White, White Electrical Construction Co., Atlanta, Ga., secretary of the Southeastern Industrial Chapter, NECA; and Dwight L. Casey, manager, Virginia & Carolinas Chapters, NECA, Charlotte, N. C. (34) David W. Murray, Harlan Electrical Construction Co., Toledo, Ohio; and Francis F. Tufts, Gray Electric Co., Detroit, Michigan.

rae's con-
in full on
am, which
dropped
to reach
next ten-
ger, Los
told the
struction
the second
approxi-
national

The use of modern high wattage appliances, and increased use of the many electric devices available for the home, makes it necessary to increase wiring circuits of adequate capacity, and convenience and lighting outlets, properly placed, with the switches for convenient control, Mr. Brand explained. In describing what use can be made of this booklet, Mr. Brand said "The Handbook is designed to be of help to architects, engineers, builders, electrical contractors, lending institutions, sellers, buyers, and home owners." He also explained that the adequate Wiring Bureau has adopted the handbook as its Standard. It is primarily a technical booklet, and is not designed as a consumer piece.

Also to be made available is a similar handbook on Farmstead Wiring, Mr. Brand said. Cooperating with the Industry Committee in the preparation of this booklet was the American Society of Agricultural Engineers, REA, and the U. S. Department of Agricul-

(Continued on page 220)

Electric
Conn.;
Electric
Ohio
Elec-
tician,
S. J.
inspec-
Rosen-
land.
Electric
(38)
R. L.
Clark,
Co.;
of the
NECA
Electrical
City;
staff;
Electric

(40) Lester F. Brooker, and R. M. Walker, of the Brooker Engineering Co., Detroit. (41) Dave Davidson, Davidson Electric Co., Brooklyn, N. Y.; S. M. Shor, Cole Electric Products, Inc., New York City; and M. D. Gruber, Gruber Brothers, New York City. (42) Tom L. Evans, chapter manager, Shreveport, La.; A. I. Korenblat, president, I-K Electric Co., Little Rock, Ark.; and NECA governor Walter Bains, Coty Rosenblaths, Shreveport, La. (43) Louis Kalischer, Louis Kalischer, Inc., Brooklyn, N. Y. (44) Ray Edensfield, Edensfield Electric Co., Nashville, Tenn.; and Paul Heydon, manager, NECA's Spokane Chapter, Spokane, Washington.

APPRENTICE TRAINING . . .

By GORDON M. FREEMAN, International Vice President, IBEW

The key to construction is skill. As contractors, you bring to a construction job skills in managing, in organizing work, in estimating materials and costs, and in general direction of the job. But ultimately your success, as well as the success of the electrical construction industry, rests squarely on the skills of the men who work with tools, building into the structures the sources and carriers of electric power. The tried, tested, successful road to adequate craft skills in electrical construction work is apprenticeship, jointly administered through local committees representing management and labor.

We have a large deficit in the skilled craftsmen needed for electrical construction. Even in normal times, the United States has never trained enough all-round skilled workers through apprenticeship to maintain the skilled labor force.

The Bureau of Apprentice Training, now happily returned to the Department of Labor, estimated a year ago that the United States needed more than 600,000 apprentices in training at all times to maintain the normal peacetime supply of skilled workers. We have never reached anything like that number. With the backlog of electrical construction now rolling toward us, the next several years won't be normal. Demands for skilled journeymen will be greater than ever.

The time to act is now. Demands for quantity and quality of skills won't wait. The time is now for another reason. At the present moment, we have an opportunity to attract veterans into apprenticeship that we shall never have again. Thirty-nine percent of the men in the armed forces have had some sort of mechanical training. Not much of this has been apprenticeship or has developed all-round skills. But that background will mean a lot.



By
George Andrae
*Chairman, NECA
Committee on
Code & Standards*

WHAT'S in the '46 CODE

Previewing many important revisions and new subjects
for the National Electrical Code to be issued next year.

FOR the first time since 1939, the Electrical Committee of the National Fire Protection Association recently met to discuss changes in the text of the 1940 National Electrical Code, leading up to the publication about one year hence of the 1946 Code. Parenthetically, it may be of interest to observe that about 500,000 copies of the 1940 Code were distributed. The task undertaken by the NECA Code Committee in Chicago, October 8, was greater than usual because of the many wartime amendments issued, and because of the introduction of new subjects never before covered in the Code, as well as the complete rewriting of the text of several Articles.

The 1946 Code will include for the first time, as a separate Article, rules pertaining to Electric Welders, indicating proper wiring rules for Transformer Arc Welders, Motor-Generator Arc Welders, and Resistance Welders. The tremendous rise in the use of welders during the war period has made the setting up of such rules a "must" item and their appearance in the 1946 Code will be welcomed by contractors all over the country who do industrial work.

Because the revision of the 1940 Code was just being finished when fluorescent lighting was coming into prominence, it was out of the question to hold up everything else while fluorescent rules were being drawn up. Consequently, we have floundered

around and have done the best we could without specific rules for fluorescents during the past five years. The 1946 edition will include a new Article 410 on Fixtures that is completely rewritten, and brought up to date to apply to incandescent and fluorescent fixtures, recessed fixtures, and special provisions for electric discharge lighting systems under 1000 volts and over 1000 volts.

Several years ago certain rules were issued as an Interim Amendment, pertaining to Machine Tool Wiring. These rules, somewhat revised, will appear in the 1946 Code as new Article 670. It should be pointed out that these rules apply only to the electrical equipment for motor-driven, complete *metal-working* machines, having one or more tool and work holding devices used for removing metal in the form of chips. Article 670 applies only to metal-working machine tools because it is the outcome of tests made only upon metal-working machines, and not upon wood-working or other machines where different hazards exist. However, a motion was passed by the meeting, recommending that a technical sub-committee be appointed to formulate rules for machines other than metal working, such as wood-working machines, and possibly also laundry machinery, grinders, etc.

Mention should also be made of new rules applying to Infra-Red Heating, another wartime development which

required action by a special committee. These rules will not appear as a separate Article, but will be incorporated in Article 210—Branch Circuits—and in Article 422—Appliances.

Many industrial plants, under one roof, have been built which extend over very large areas. Feeders in such buildings had to be over-size to avoid excessive voltage drop. The development of transformers with a liquid that will not burn (known as the askarel type), has made it possible to install such transformers at various points throughout the building without the use of vaults. This permits bringing high-tension feeders inside of the plant to the several transformer locations, with less copper, and with improved voltage on the feeders and branch circuits. Such an installation would generally be of the radial type. However, where very large loads are encountered, the industrial network system has also found favor, as it employs a loop wiring method that ties together a number of transformers or groups of transformers, which may be of considerable size. For the first time, the 1946 National Electrical Code will incorporate rules for such high-capacity industrial network distribution systems.

Another special committee made a report on the wiring of Prefabricated homes. It was found that no manufacturer of prefabricated homes had anything developed and ready for quantity

production, upon which committee study and resultant recommendations could be based. It was therefore decided to use the existing code wiring methods. However, Article 390 has been set up as a new Code Article on Prefabricated Homes, and the co-operating bodies will be invited to nominate members to represent them, if interested, on this Article Committee.

The increasing use and importance of control circuits has brought about the writing of a completely new article, known as Article 725, which will apply to Remote Control, Low Energy Power and Signal Circuits. These rules will appear for the first time in the 1946 Code.

A technical subcommittee was appointed to study the practicability of developing an intermediate wall thickness conduit, to replace both the present heavy wall and thin wall types. During the discussion it was stipulated that such a study should only be undertaken with the understanding that we end up eventually with one type of conduit and not with three.

The increasing use of welders within the past few years, as well as the use of other shop and construction equipment with heavy cords, has emphasized the inadequacy of existing receptacles and plugs for the service demanded. It was therefore recommended, and a motion to that effect passed, that a special committee be appointed to study the question of suitable heavy duty receptacles and plugs for motors, welders, etc. I think this action will be welcomed by many contractors, and it is to be hoped that the development of heavy duty receptacles and plugs of suitable types will soon be undertaken by the manufacturers.

We have seen many new industrial applications of X-ray and High Frequency Equipment, which were not contemplated in the formulating of rules for Article 660 of the 1940 Code. This Article is therefore to be revised before the end of this year and voted on by letter ballot, in an effort to bring it up to date and reconcile the 1940 text, the 1942 and 1945 Preprints, the Article Committee recommendations, and various requests by NEMA. Furthermore, a motion was carried asking that a technical subcommittee be appointed to study industrial X-ray and high frequency applications.

Closely related to the foregoing was the action taken to set up a new article for Hospital Wiring, including X-ray and High Frequency Medical Equipment. Hospitals present conditions and hazards peculiar to themselves, and

they are of sufficient importance to warrant treatment in a separate article. It is to be regretted that such rules are not available at the present time, in view of the large new hospital construction program that will soon begin all over these United States.

All of what I have reported so far applies only to *new* or *special* items that were given consideration.

All Interim Amendments passed by the Emergency Committee (except No. 69 previously withdrawn) will remain in effect until the next code goes into effect. And that will probably be about November 1946.

A new Article 310—Conductors—appears in the 1946 Code for the first



GEORGE ANDRAE

time and is of very great interest to contractors and wiremen. As a member of this committee, I am not entirely satisfied with the action taken on certain wire sizes and types, but I believe that by the time the next Code is written, the lack of demand for certain wires will facilitate their removal. It was my hope, and apparently that of most of the others to have one column and one column only for rubber-covered building wires; however, we will now have two, one for RH, and one for R, which will be the equivalent of the former RP or intermediate grade. We had also hoped to do away with No. 10 at 25 amperes and No. 8 at 35 amperes, and have a new No. 9 at exactly 30 amperes to correspond to the rating of standard switches, cutouts, and fuses. We shall have our 30 ampere wire, but it will be No. 10, with improved insulation which permits raising the

rating from 25 to 30 amperes. And the ratings will be 15, 20, and 30 ampere for No. 14, 12, and 10 wires, whether they are R, RW, RH, RV, T, or TW (formerly called SN and SNW).

No. 8 wire with improved insulation in both types R and RH, will have its rating boosted to 40 and 45 amperes. No. 6, similarly, from 50 amperes to 55 for R and 65 RH. Beginning with No. 4 wire, the carrying capacities for Type RH are appreciably higher than for Type R and approximate the values we had in the 1937 Code. The corresponding carrying capacities for Type R wires are so much lower that to use these wires would appear impractical unless there is a considerable price differential. It is my hope that most manufacturers of rubber covered building wires will standardize on Type RH, and through such standardization effect economies that will result in a competitive price structure and eliminate this needless duplication of stock items. Please bear in mind that No. 14 and No. 12 rubber covered wires will be made only with thin insulation.

During the war and by action of the Emergency Committee, Type SN wire (hereafter to be designated as Type T—"T" for thermoplastic) was permitted on new work wherever Type R had been permitted, subject to certain tables. The Electrical Committee at its session during the week of October 8, voted as follows regarding the use of Type T and TW:

(1) O. K. for open wiring up to 2 million CM.

(2) For general use, including armored cable and non-metallic sheathed cable, up to and including 4/0.

(3) In conduit and electrical metallic tubing, up to and including 4/0 for new work, according to Table 4 of the 1940 Code.

(4) For rewiring of existing raceways, in accordance with the last line of Table 11 of 1940 Code.

After considerable discussion and quite some controversy, the above was unanimously adopted as a compromise solution.

We now come to our old friend, the so-called Type "S" non-tamperable fuses. Personally, I am somewhat prejudiced on this subject, being considerably influenced by the fact that in Wisconsin Type "S" fuses have been required since January 1, 1941, and we are getting along quite well—thank you! I therefore spoke and voted in favor of the inclusion of a mandatory requirement for non-tamperable fuses in the next Code. I am glad to report

(Continued on Page 109)

By
S. C. Sachs
*Chairman, NECA
Inter-Industry Committee*

TEAM WORK WANTED

**Contractors must shoulder full load and responsibility
in sales effort to merit share in profits of distribution.**

THE Electrical Industry is a team. It is a team that should draw about the biggest gate receipts in post-war America because it has more to offer that is new, labor-saving and enjoyable than the others.

This team is made up of:

The utilities, who sell power to the consumer and perhaps have more frequent contact with him than do other members of the team.

The contractor, who may not leave his calling card so frequently—maybe only once if he does a perfect job—but

upon his knowledge and skill depends the entire chain of electrical service. Without a proper installation the utility sells less electricity and the prestige of product and name of manufacturer and distributor suffers.

The wholesaler, who supplies the electrical contractors and the appliance dealers.

The manufacturer, who fosters research and makes the products upon which a great part of our insatiable search for a higher standard of living depends.

This team requires the functioning of each member at the maximum of his ability. Chiseling and short-sighted maneuvers for individual or even industry group advantage cannot be tolerated.

Ours is a comparatively new team. But being new we should have the advantage of freedom from hidebound tradition that often impairs progress. The opportunity is at hand for us to show the way by effective and practical inter-industry cooperation. We owe that much to our new boss in peacetime America, the consumer. We feel that we can make his life much fuller by the wide and intelligent use of electricity. That is a job that demands the full attention of all of us, the utility, the contractor, the wholesaler and the manufacturer.

There are two lines of activity that we Electrical Contractors must get into; every one of us, and keep at it day in and day out.

One is to make certain that our approach to our jobs includes effective performance as an efficient distributor of electrical materials and equipment as well as providing a qualified installation service. That means salesmanship that increases demand for a manufacturer's product. All of which means that we must become, and become known as, a necessary link in the chain of distribution in our industry and not merely as a provider of labor and engineering skill.

The other activity is to see that, once having established our reputation as an engineer-salesman-retailer, our teammates and ourselves play the game fairly and squarely.

Keeping the Rules of the Game

This is a matter of voluntary industry regulation. By regulation we do not mean laws, bureaucratic decrees or punitive agreements, boycotts, blacklists, whitelists or other recourses which may or may not be inside the penumbra of our anti-trust statutes.

We mean the regulation by educational means for the enlightened self-interest of each individual and each segment of the industry; of salesmanship and individual persuasion.

We must lay aside any thought of dependence on government in working out our inter-industry relations, except in those rare and blatant instances patently calling for the services of a

(Continued on Page 111)



SLIMLINE SELLS

Sporting Goods

Model store lighting project in St. Louis features new type fluorescent lamps in a modern planned lighting layout.

By August Eckel



Eight foot G. E. slimline fluorescent lamp is easily installed in the 4-lamp eight foot long recessed fixture during construction.

LIGHTING was given the green light to the tune of some \$10,000 for fixtures and lamps in the new home of the American Sporting Goods Company in St. Louis. With wiring for power and light at \$8,000 and another \$3,000 in wiring for air conditioning, the importance of modern lighting in facilitating sales and holding down operating expenses is clearly demonstrated.

Harold Siebens, president of the company which distributes and retails athletic equipment and sporting goods on a national scale, wanted the best

lighted and most modern store in the city. A veteran in the merchandising field, he appreciated the importance of lighting as a sales tool. With Design, Inc., architects and engineers of St. Louis commissioned to remodel the building, the John O. Ledbetter Electric Company was the electrical contractor. The following basic specifications for the lighting system were set up.

1. The light must be designed for
 - a. Atmosphere
 - b. Attraction
 - c. Appraisal (Selling)
2. Their thinking was in terms of "lines of light" to blend with the sleek, modern store interior.
3. An average maintained intensity of at least 50 footcandles was desired in the general sales areas.
4. All light sources must be shielded.
5. Lighting must be of the "instant start" type.

Based on these specification "musts", lighting engineers submitted their ideas and designs—all geared to produce the desired results. Every factor entering into a *planned lighting* installation was carefully considered—initial and operating costs, quantity and quality of light, adaptability of the light source to the task at hand and the architectural treatment of the store interior, installation and maintenance ease, and flexibility of the system. Since this air conditioned, windowless store incorporates a unique all-glass front with no defined show window (the store interior being the display), the lighting layout was of vital importance.

The final decision, after all available light sources and submitted designs

DATA ON SLIMLINE LAMPS USED

Lamp Designation	Lamp					Rated Lumens		Recommended minimum starting voltage
Type Size Color	Length [®]	Dia.	Watts	Amps.	Volts	Total	Per Watt	
F96T8/W	96"	1"	52	0.2	290	3300	63	700
	96"	1"	30	0.1	335	1950	65	700
F72T8/W	72"	1"	38	0.2	215	2350	62	600
	72"	1"	22	0.1	245	1400	64	600
F64T6/W	64"	3/4"	38	0.2	230	2150	57	600
	64"	3/4"	23	0.1	270	1400	61	600
F42T6/W	42"	3/4"	25	0.2	145	1400	56	450
	42"	3/4"	15	0.1	170	900	60	450

Note: Data from G. E. Lamp Dept.



View of main sales floor during construction with lighting troughs turned on for testing.

had been carefully studied, was to install an all-fluorescent system with incandescent highlighting applications. The belief was that this system met all the requirements and yet was economical from the long-term viewpoint. Because of their adaptability to the specified "line of light" treatment, the new slimline fluorescent tubes were chosen to predominate the layout.

The decision to use slimline tubes was based, among others, on the following considerations:

1. **Initial Cost**—With the specified lighting intensity as the basis of comparison, it was estimated that a slimline layout takes one-third less lamps than a comparable cold cathode system; 50 percent less lamps than the conventional 40-watt fluorescent system. To this is added the savings in ballasts (and starters when compared with the conventional fluorescent lamp).

2. **Lumen Output**—The 63 lumens per watt rating of the 8 ft., 200 ma., slimline lamp was the highest. Similar ratings of the 8-ft., 120 ma., cold cathode tube is approximately 56; that of the conventional 40-watt fluorescent lamp, 53.

3. **Maintenance Ease**—The slimline lamps can be quickly installed and renewed. The combination single-pin lamp contacts and one-piece porcelain lampholders with spring and prong contacts eliminate all twisting, turning and "snapping in" and the lamps cannot fall out—an important factor when lamps are renewed at the 16-ft. ceiling height in the main sales. Also, as a safety feature, the fixed contact lampholder is designed so that, upon removal of the lamp, the circuit is automatically broken and there is no voltage at either lampholder.

4. **Flexibility**—The same lamp—

with a different ballast—can be operated at 200 milliamperes for high total lumen output, or 100 milliamperes for a lower lumen output. Standard fixtures can be used throughout the system and only one type of renewal lamp need be stocked. The color quality of the slimline and conventional fluorescent lamp is identical, so both can be used in the same area if desired.

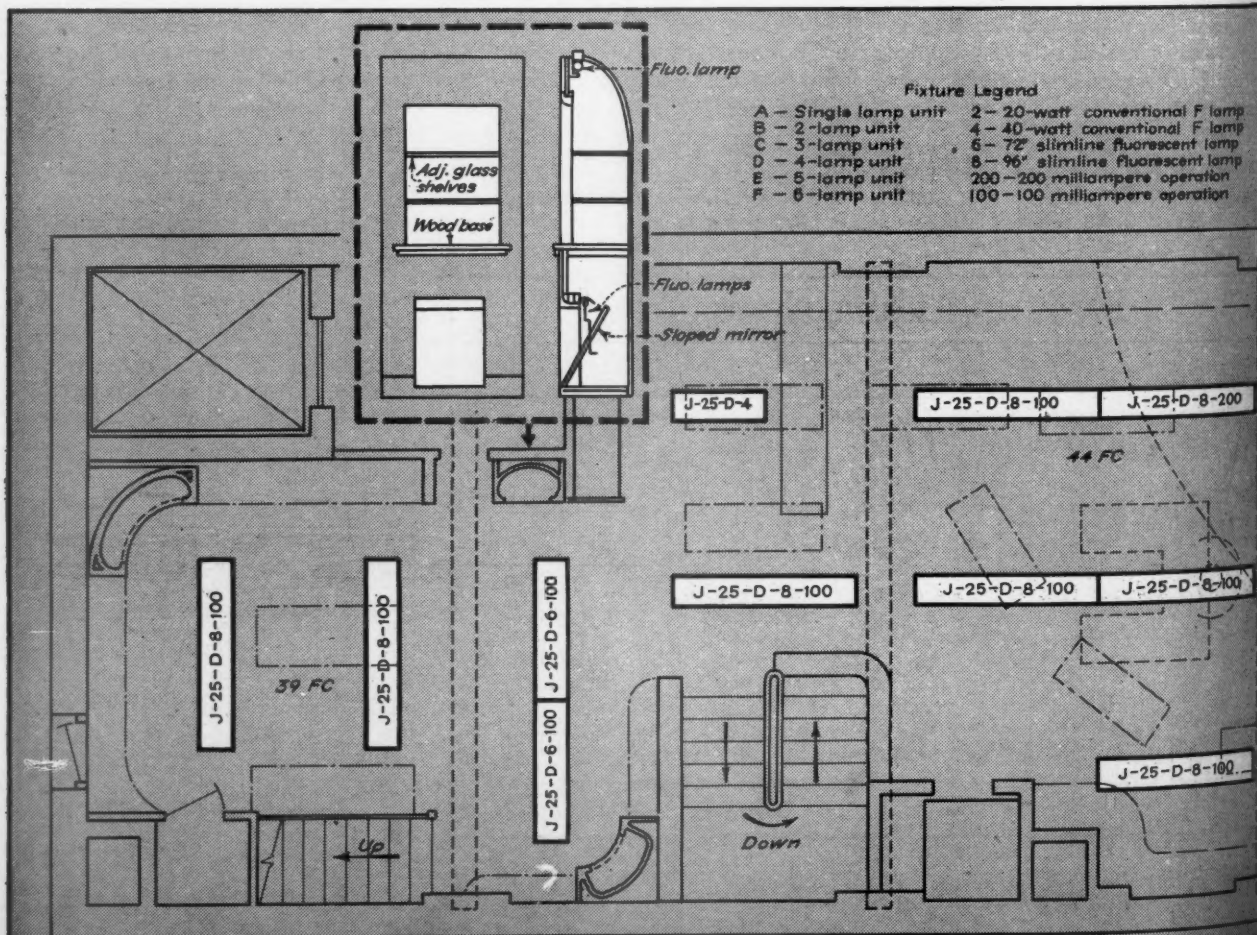
5. **Operation**—A fired-in graphite stripe in the tube facilitates lamp starting under high humidity or low temperature conditions. In an emergency, lamps will start at 100 volts. Free rotation of the lamp permits hiding this gray stripe from view.

Fixtures were designed and fabricated by the Joleco Corporation of St. Louis with General Electric Company ballasts, lamps and lampholders. Three basic designs were required for recessed and surface mounted general lighting and the concealed show case illumination.

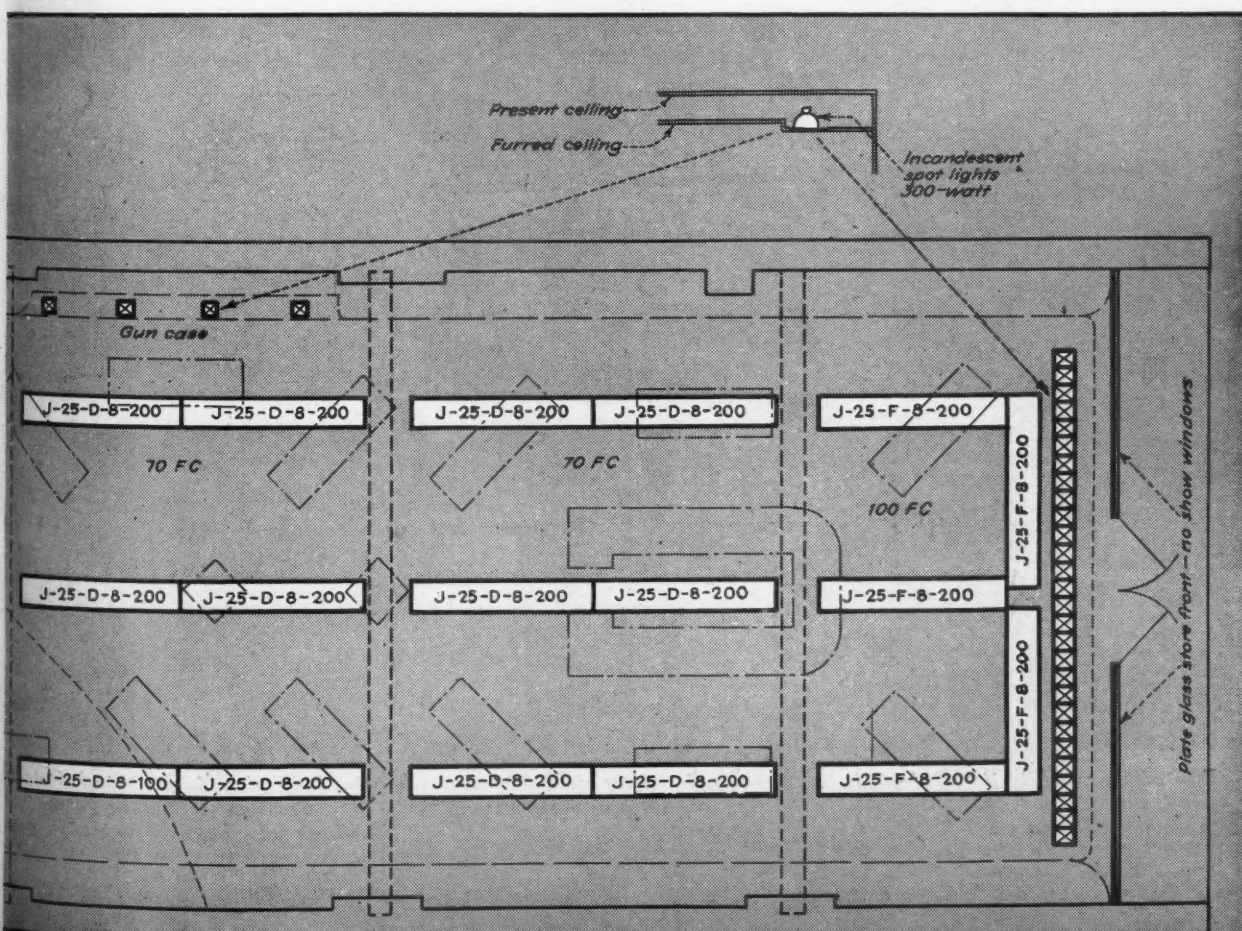
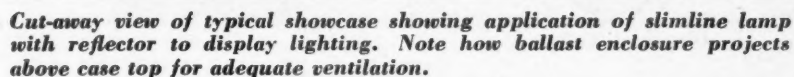
Main Sales Area

The layout for the main floor sales area embodies sweeping, high-intensity—yet comfortable—lines of light producing an average of 70 footcandles at merchandise level. Three semi-continuous rows (each composed of double, 8-ft. sections) of recessed, louvered fixtures are mounted flush in the 16-ft.,

Plan view of lighting layout for main sales floor, including ceiling over mezzanine. Note details of incandescent spots and display niche treatment.



The rear half of the 27-ft. by 100-ft. main sales area is divided by a mezzanine floor producing a 7-ft., 8-in. ceiling under and a 7-ft., 2-in. ceiling above the balcony. The fixture pattern above the balcony continues the lines of light



seen from the main sales floor. Due to the low ceiling height, however, the units are operated at 100 milliamperes (lower lumen output) using the same lamps as are in the main floor fixtures. General lighting in this area (shoe sales) averages 45-50 footcandles.

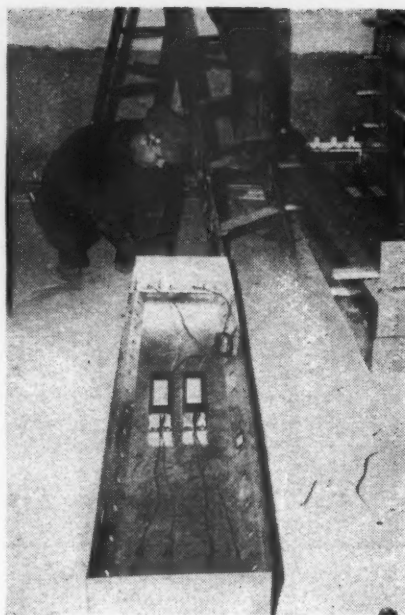
Under the mezzanine, double 4-lamp, 6-ft. slimline fixture sections are used. They are recess mounted in rows, on 7-ft., 6-in. centers, parallel to the store width because of structural restrictions. With the lamps operating at 100 milliamperes, the intensity in this area averages 45-50 footcandles.

In the general sales area, the vertical component of the ceiling lighting units serves to highlight photo-murals over the wall display cases.

Display Lighting

Display lighting, in general, consists of single-lamp, slimline fixtures with suitable reflectors concealed under the top of the showcase. The $\frac{3}{4}$ -in. diameter (64-in. and 42-in. length) lamps, operated at 200 milliamperes are used. Where the show cases are too short, or where curved unit display niches along edge of mezzanine are encountered, the shorter conventional fluorescent lamps are used. Glass shelving is employed extensively so the light can penetrate and highlight all the merchandise on display in the case.

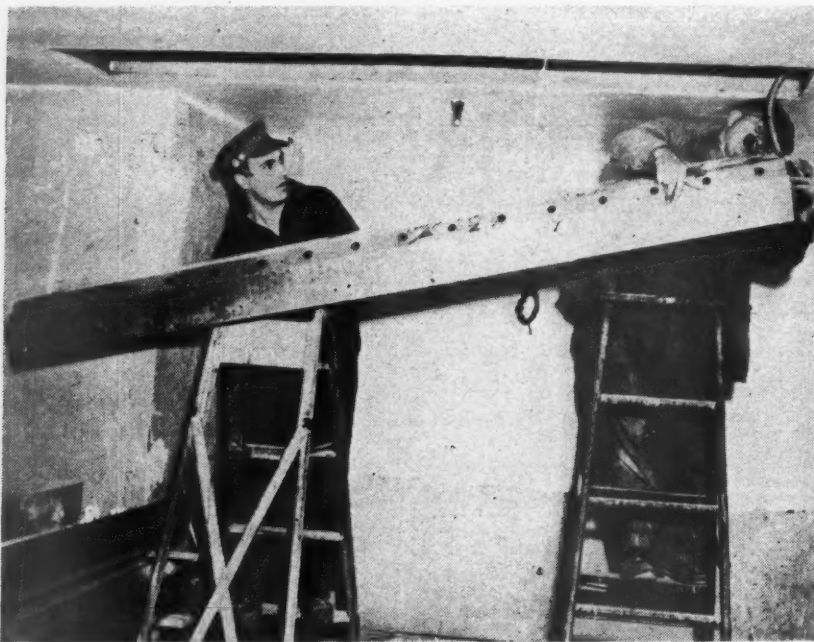
On the main floor, the gun display and wall photo-mural are accentuated by highlighting from four 300-watt incandescent spotlights concealed in



Long slimline fixtures come to the job completely wired. Flexible conduit connection is made to knockout in end plate of trough. Note large holes on each side of trough for air circulation over ballasts.

the ceiling directly over the rack.

The second floor of the building is devoted to merchandising such large bulky items as boats, canoes, etc. For this display, 45 footcandles of general illumination is provided by individual, surface-mounted fixtures on approximately 9-ft. by 12-ft. center-to-center spacing. Units parallel the exposed, plaster-encased beams on a 10-ft., 10 $\frac{3}{4}$ -in. ceiling. Each fixture contains four, 96-in. lamps operated at 200 ma.



Two men can easily install the 8-ft. fixture trough. After circuit connection is made, unit is inserted in ceiling opening and sides securely screwed to wood frame support.

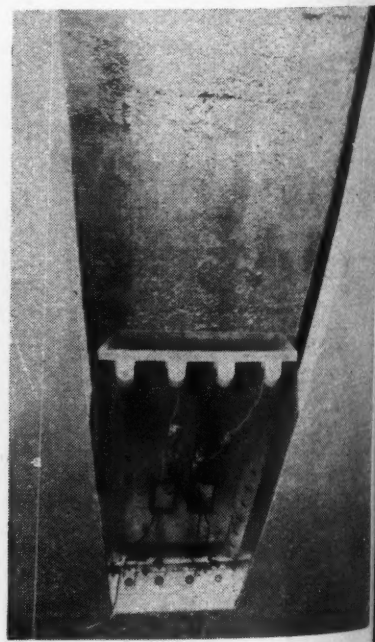
Sporting apparel is displayed on the third floor. Here the general lighting intensity is increased to 50-60 footcandles. Two continuous rows of surface-mounted units, on approximately 8-ft. centers, are installed in each bay. Each row, paralleling the beam, is composed of one 4-lamp, 8-ft. fixture in the center with a 4-lamp, 6-ft. unit at each end. All lamps operate at 200 ma., at the 10-ft., 10-in. ceiling height.

Office Lighting

All general and private offices of the company are located on the fourth floor of the building—also windowless. In accordance with recommended practice, a general, average illumination intensity of 50-foot candles is provided. In the general office area, four semi-continuous rows of units on 6-ft. centers are recessed in the 9-ft., 4-in. suspended ceiling. The single break in each row is due to the air duct. Each row contains one 4-lamp, 8-ft. unit and two 4-lamp, 6-ft., units—all lamps operating at 200 milliamperes.

Private offices are illuminated by two parallel units (four lamps each) on 6-ft. centers. The larger offices have 8-ft. lamps; the smaller ones, 6-ft. lamps.

Sunlight is literally transplanted indoors in the private offices. In the center of each office, concealed in the suspended ceiling is a permanently mounted S-2 sunlamp, the type under which one can safely sit all day and acquire a healthy tan.



One-half of a 12-ft. trough installed in a recessed ceiling opening. Note ballasts are mounted to fixture body.

Tolerance Control

Vacuum tube timers on radius grinders boost quality control at a Chicago bearing plant.

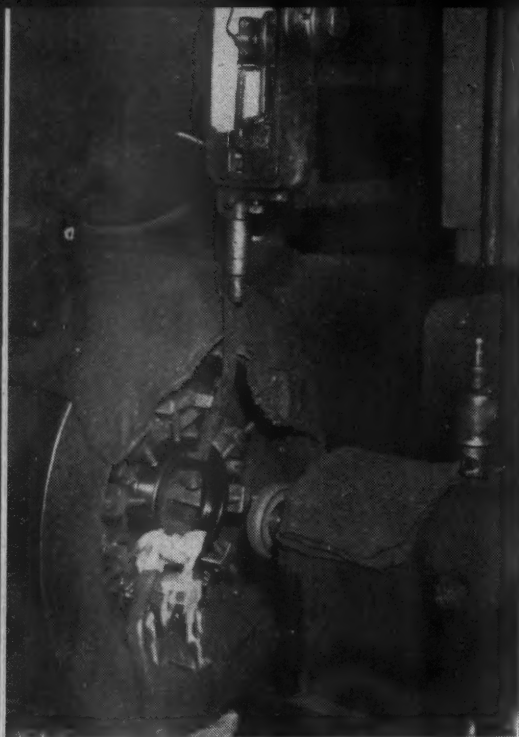


FIG. 1—Tolerance gage with micrometer adjustment and three-position electrical contact lever (rough, off and finish) controls grinding cycle. Spring tension guide arm under gage rides groove radius of bearing race and actuates contact lever.

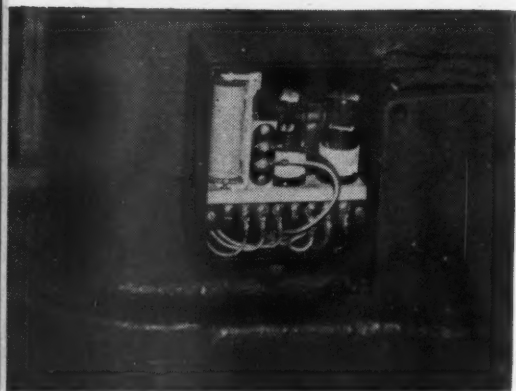


FIG. 2—Dual electronic switch mounted to base of machine amplifies minute tolerance gage currents for operation of vacuum tube time delay relays in coolant and feed motor circuits. One tube is for rough and one for finish grind contact on gage.

FIG. 3—Vacuum tube time delay relay controlling forward and reverse cycle operation of grinding wheel feed motor. A similar relay opens and shuts coolant solenoid valve for rough (wet) and finish (dry) grind.

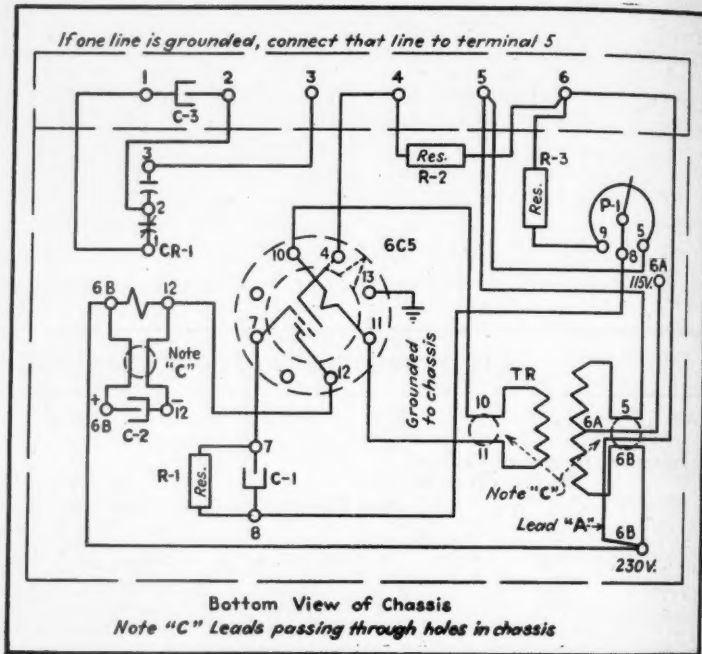
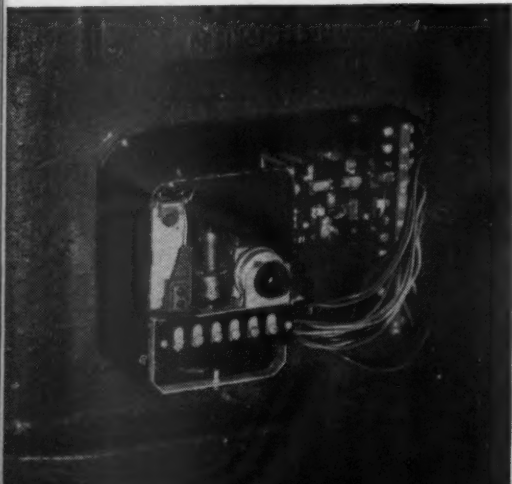


FIG. 4—Circuit diagram of vacuum tube time delay.

THE term industrial electronics too frequently conveys to the plant electrician the impression of a huge expensive control unit loaded with vacuum tubes and complicated circuits with which he is quite unfamiliar. For some applications this is true, but there are numerous instances where a simple electronic device will do a job that no other electrical or mechanical control could accomplish.

A pertinent example of this was found at the Ahlberg Bearing Company in Chicago. Prior to the war this concern, like others in the industry, was operating its radius grinders with semi-mechanical and manual control. Mechanical timers with their cam accessories soon became victims of wear and there was always the inherent element of human error where manual control is employed. The net result was a rapid increase of rejects when control parts need replacement and with a definite shortage of skilled operators this evolved into a first class problem. In an industry of this type, where tol-

erances of two ten-thousandths of an inch must be maintained, such a condition can become a critical production bottleneck.

When the demands for bearings skyrocketed during our defense period, the Ahlberg management decided to convert their radius grinders to fully automatic operation permitting a single operator to man a group of units. Thus they were ready to do their part in the critical wartime production of bearings. Because of the tolerances required and the continuous production indicated, they decided to utilize simple vacuum tube controls where possible.

Two distinct operations are involved in grinding the curved groove (where the ball bearings are seated) of a ball bearing race: The first, or rough grind with coolant; the second or final grind without a coolant. To keep within the requisite tolerances, a gage controls the grinding operation (Fig. 1). This assembly comprises a spring actuated guide arm which rides the radius of the race. When the groove reaches the

proper depth, the lever in the position and (right position) grind). A contact position and started. T automatically s has been r

FIG. 5—S grinder op left corner

Through Electronic Timers

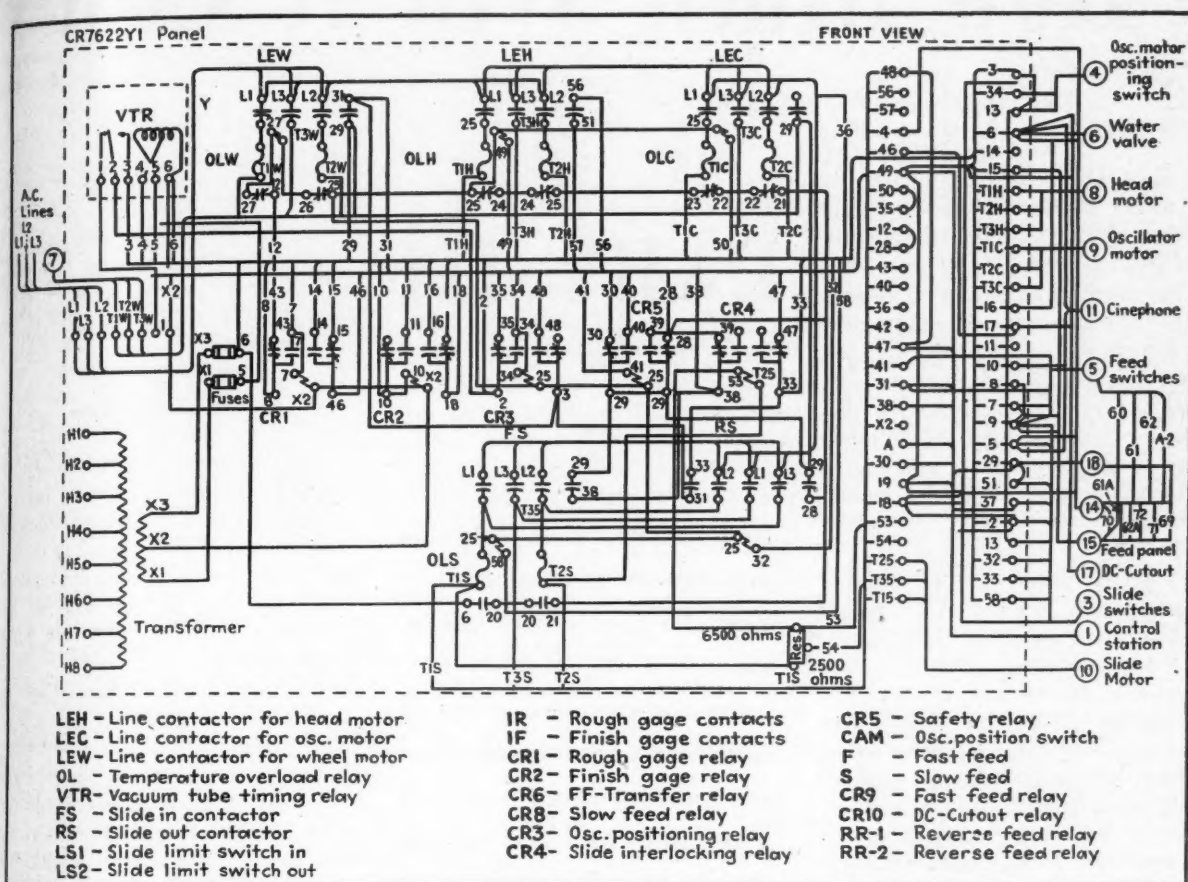


FIG. 6—Wiring diagram of sequence relay control panel shown in Fig. 5.

proper depth, a double electrical contact lever in the gage opens to the center position and the grinding wheel stops (right position of contact is for rough grind). After a predetermined time, the contact lever moves over to the left position and the finish or dry grind is started. The grinding operation automatically stops when the proper depth has been reached, the grinding head is

retracted and the race removed.

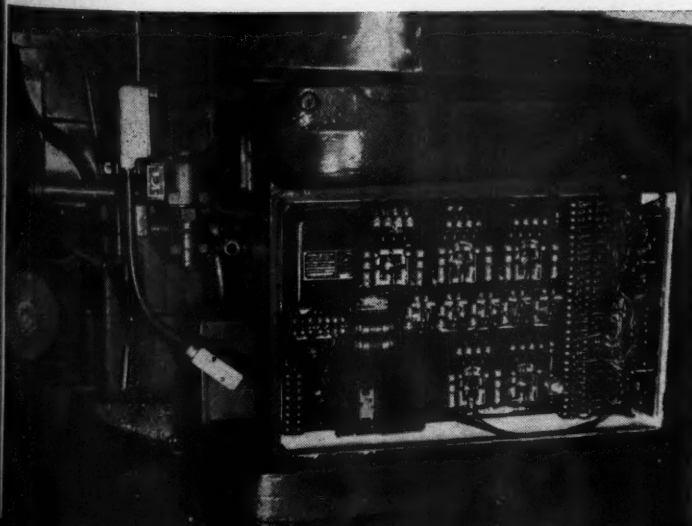
Three simple vacuum tube control units are involved in this grinding cycle. The first, a United Cinephone dual electronic switch is inserted in the circuit between the tolerance gage and the electronic timers on the machine control. This is nothing more than an amplifier to boost the minute current in the gage contacts to a level

where the automatic timer will operate. The two tubes in this switch (Fig. 2) are for the two contact circuits of the gage—rough and finish grind. Two G. E. Vacuum tube time delay relays complete the electronic equipment in the automatic control. One relay operates the solenoid valve of the coolant system, turning it on for the rough

[Continued on page 221]

FIG. 5—Sequence relay control panel for the complete radius grinder operation. Note vacuum tube time delay relay in upper left corner of panel.

FIG. 7—Tubes are tested monthly by chief electrician F. G. Koch, assuring trouble-free operation of the machines.



How Much Will It Cost

?

PART III

WHETHER the contractor is aware of it or not, every time he submits a preliminary figure, he obligates himself. He quotes a price and the client expects him to deliver the job for that figure. The contractor may assume that if his proposition includes a listing of just what was included in the estimate, he will be able to discharge his obligation with impunity. Such, however, is not always the case. Regardless of the listing, the client usually expects a complete installation.

A request is made for a preliminary estimate on a hospital. Information may be forthcoming on lighting, power, and nurses call only. But the price is supposed to represent the complete cost, including all other branches of the work. The owner's representative assumes that the contractor knows all about hospitals, and will include allowances for X-ray, doctors paging system, operating room grounding, emergency lighting and all other essential systems. Architects and engineers want contractors who will do some thinking for them. They want assistant buyers, not salesmen.

The particular phase of preliminary estimating is stressed here because this article deals with panels and cabinets—a branch of the work which especially emphasizes the need for anticipating job requirements. In establishing allowances for distribution equipment one has to reasonably well anticipate:

1. Additions—due to the equipment overlooked in the buyers listing.
2. Changes in equipment size.
3. Shifting of equipment.
4. Allowances for future equipment.

Any contractor who has made layouts for sizable projects knows that preliminary motor and equipment lists may be incomplete. Invariably there are additions of unit heaters, fans, pumps, production and utility motors in general. The buyer will readily grant the contractor's right to charge for the motor installation and branch wiring, but frequently hesitates on additions for panel and distribution costs.

Changing motor sizes or shifting motors from one location to another

Panelboards and cabinets are important cost items in any electrical installation. How can one quickly estimate the installed price of numerous combinations of the more common types? The tables and text of this article give the answer.

By Ray Ashley
Research Engineer
Electrical Contractors
Association of City of Chicago

may affect panel costs. We will see later how the largest circuit on a panel determines the price for all the branch circuits. A panel may have 20 branch circuits, none larger than 100 amperes. If a 20 hp. motor, to be fed from this panel, is increased to 25 hp., a 200-amp. branch must be provided. This change increases the width of the panel, hence the cost of all 20 circuits will be increased. Similar cost increases may result from shifting motors in different building locations.

Provision of spare circuits on panels is taken for granted by good architects and engineers and is standard practice with the better electrical contractors. The capacity of future circuits can be determined by studying the type of installation and original panel requirements.

Selection of the type of equipment suitable to the job and acceptable to the owner is another factor. Unless

he is sure, the contractor should submit his recommendations to the buyer before preparing the estimate. With distribution requirements settled, an estimator can quickly prepare a price with the aid of tables similar to those illustrated.

The Panel Units

The accompanying tables of panel units are patterned after an ingenious method adopted by some switchboard manufacturers. As the setup is typical for all open type panels, the immediate discussion will be confined to "Sheet 3" in Fig. 4, covering 250-volt, 3-phase, 3-wire panels.

Each of the four sheets for open type panels has two tables: The top table for "fuses only" in the branches; the lower tables for "fused-switch" branches. Each table has two sections: The upper one is for branch circuits; the lower shows cost additions for the mains.

If you study Sheet 3, Fig. 4 (typical panel cost data sheet arrangement) you will find a list of the circuits to be figured in the first column headed "Capacity of Circuits." Across the top of each table is a listing of the "largest branch circuit on the panel." Two columns are under each branch circuit indication. The first shows the *base material price* of each panel unit ("P"—the contractor's purchase price of the panel unit; "F"—the cost price of fuses included in the selling price). The second column "*Selling Price Installed*" (in bold type) includes all labor, job costs, overhead and return and *is the figure to be used for preliminary estimating*. The units in light type under the material column are for reference and analysis, or for establishing base costs. Figure 1 indicates the table factors entering into the determination of the selling price of a 60-ampere branch circuit unit in a polarity type panel with the largest circuit on the panel being a 200-ampere unit.

To get a selling unit for branch circuits, select the capacity of the circuit to be priced in the first column, then follow the horizontal line to the "selling unit" column of the largest branch cir-

cuit on t
a 30-amp
Fig. 4, t
circuits l
be \$6.60.
amperes,
\$7.70; if
up to \$1
ampere t

To the
cuits mu
mains.
table, se
fuses, or
zontal lin
below the

It is o
circuit o
the base

A pane
wide wo
branches
200-amp
proximat
branch c
ampere b
panel ins
quently a
to be ma

Most
mains f
prices w

Example

Panel
250-volt

ITEM
PRICE

UNIT FIG.	CAP.	P	F	Selling Price Installed
1	15			
2	20			
3	25			
4	30			
5	35			
6	40			
7	45			
8	50			
9	55			
10	60			
11	65			
12	70			
13	75			
14	80			
15	85			
16	90			
17	95			
18	100			
19	110			
20	120			
21	130			
22	140			
23	150			
24	160			
25	170			
26	180			
27	190			
28	200			
29	220			
30	240			
31	260			
32	280			
33	300			
34	320			
35	340			
36	360			
37	380			
38	400			
39	420			
40	440			
41	460			
42	480			
43	500			
44	520			
45	540			
46	560			
47	580			
48	600			
49	620			
50	640			
51	660			
52	680			
53	700			
54	720			
55	740			
56	760			
57	780			
58	800			
59	820			
60	840			
61	860			
62	880			
63	900			
64	920			
65	940			
66	960			
67	980			
68	1000			
69	1020			
70	1040			
71	1060			
72	1080			
73	1100			
74	1120			
75	1140			
76	1160			
77	1180			
78	1200			
79	1220			
80	1240			
81	1260			
82	1280			
83	1300			
84	1320			
85	1340			
86	1360			
87	1380			
88	1400			
89	1420			
90	1440			
91	1460			
92	1480			
93	1500			
94	1520			
95	1540			
96	1560			
97	1580			
98	1600			
99	1620			
100	1640			

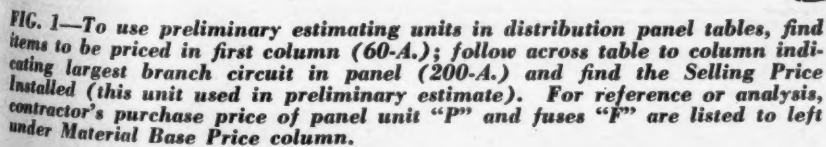
FIG. 1—
Items to
be priced
installed
contractor
under M

Most estimators prefer to cost the mains first. Following this order, prices would be estimated as follows:

Panel Specification: 3-phase, 3-wire, 250-volt polarity (fuses only in

Panel Specifications: 3-phase, 3-wire,

Text continued on page 227
tables on following pages



2W. FUSED BRANCHES—POLARITY TYPE

CAP. OF CTS.	30 A.		60 A.		100 A.		200 A.		400 A.		600 A.	
	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED
30 A.	P 1.80 F .50	4.85	P 2.10 F .50	5.30	P 2.40 F .50	5.70	P 3.00 F .50	6.50	P 3.30 F .50	6.95	P 3.60 F .50	7.10
60 A.			P 2.40 F 1.00	6.95	P 3.00 F 1.00	7.80	P 3.60 F 1.00	8.60	P 4.20 F 1.00	9.40	P 4.50 F 1.00	9.50
100 A.					P 4.50 F 2.25	12.90	P 4.80 F 2.25	13.50	P 5.40 F 2.25	14.40	P 6.00 F 2.25	15.10
200 A.	USE COL. OF LARGEST BR. CT. ON PANEL. P—DESIGNATES CONTRS. PUR. PRICE OF PANEL EQUIPMENT. F—DESIGNATES CONTRS. PUR. PRICE OF REN. FUSES.						P 6.30 F 5.00	19.70	P 6.90 F 5.00	20.70	P 7.80 F 5.00	22.10
400 A.									P 12.00 F 9.00	34.50	P 13.50 F 9.00	36.00
600 A.											P 24.00 F 13.60	54.00
ADD FOR	100 A.		200 A.		400 A.		600 A.		800 A.		1200 A.	
LUG MAINS	P 13.20 F 2.25	20.00	P 15.00 F 2.25	24.00	P 25.80 F 9.00	38.50	P 33.00 F 13.60	51.00	P 42.00 F 18.00	68.00	P 58.00 F 27.20	94.00
FUSED MAINS	P 17.20 F 2.25	28.00	P 21.40 F 5.00	38.00	P 39.00 F 9.00	65.00	P 53.00 F 13.60	90.00	P 68.00 F 18.00	117.00	P 94.00 F 27.20	167.00
NO. F. MAIN SWITCH	P 23.50 F 2.25	32.00	P 25.80 F 5.00	37.50	P 50.00 F 9.00	67.00	P 69.00 F 13.60	93.00	P 91.00 F 18.00	123.00	P 117.00 F 27.20	163.00
FUSED MAIN SW.	P 25.80 F 2.25	38.00	P 32.00 F 5.00	54.00	P 58.00 F 9.00	88.00	P 84.00 F 13.60	125.00	P 112.00 F 18.00	168.00	P 141.00 F 27.20	221.00
METER LOOPS	P 2.70 F 2.25	9.80	P 3.60 F 5.00	17.00	P 5.40 F 9.00	20.00	P 7.20 F 13.60	26.00	P 9.00 F 18.00	35.00	P 12.00 F 27.20	50.00

2W.—2P. FUSED SW. BRANCHES

CAP. OF CTS.	30 A.		60 A.		100 A.		200 A.		400 A.		600 A.	
	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED
30 A.	P 6.00 F .50	9.70	P 6.60 F .50	10.55	P 7.50 F .50	11.90	P 8.10 F .50	12.70	P 9.00 F .50	13.80	P 9.90 F .50	15.10
60 A.			P 8.40 F 1.00	14.00	P 9.60 F 1.00	15.50	P 10.80 F 1.00	17.00	P 12.00 F 1.00	18.50	P 13.20 F 1.00	20.10
100 A.					P 13.20 F 2.25	23.00	P 15.00 F 2.25	25.40	P 16.80 F 2.25	27.60	P 18.60 F 2.25	30.10
200 A.	USE COL. OF LARGEST CT. ON PANEL. P—DESIGNATES CONTRS. PUR. PRICE OF PANEL EQUIPMENT. F—DESIGNATES CONTRS. PUR. PRICE OF REN. FUSES.						P 19.20 F 5.00	35.00	P 21.50 F 5.00	38.00	P 24.00 F 5.00	41.10
400 A.									P 36.00 F 9.00	62.00	P 38.30 F 9.00	65.10
600 A.											P 55.80 F 13.60	94.00
ADD FOR	100 A.		200 A.		400 A.		600 A.		800 A.		1200 A.	
LUG MAINS	P 23.40 F 2.25	31.50	P 25.40 F 5.00	36.00	P 40.00 F 9.00	56.00	P 54.00 F 13.60	75.00	P 67.00 F 18.00	94.50	P 87.00 F 27.20	127.00
FUSED MAINS	P 29.00 F 2.25	41.00	P 36.60 F 5.00	55.00	P 62.00 F 9.00	91.50	P 86.50 F 13.60	128.00	P 112.00 F 18.00	167.00	P 148.00 F 27.20	228.00
NO. F. MAIN SWITCH	P 33.50 F 2.25	43.50	P 39.40 F 5.00	53.00	P 70.50 F 9.00	91.00	P 98.00 F 13.60	126.00	P 125.00 F 18.00	162.00	P 161.00 F 27.20	212.00
FUSED MAIN SW.	P 39.40 F 2.25	53.00	P 50.50 F 5.00	75.00	P 85.00 F 9.00	119.00	P 125.00 F 13.60	172.00	P 178.00 F 18.00	242.00	P 205.00 F 27.20	282.00
METER LOOPS	P 3.60 F 2.25	11.00	P 5.40 F 5.00	20.00	P 7.20 F 9.00	23.00	P 9.90 F 13.60	30.00	P 12.60 F 18.00	40.00	P 17.00 F 27.20	57.00

1—20% WAS ADDED TO INST. LABOR FOR INSURANCES, TOOLS, & OTHER DIRECT JOB COSTS.
2—MARKUPS USED MATERIAL—10% FOR GEN. OVERHEAD & RETURN.
LABOR—15% FOR GEN. OVERHEAD & 10% FOR RETURN
3—VACANT SPACES ARE FOR CONTRACTOR'S ADJUSTED PRICES.

ELECTRICAL CONTRACTORS' ASSN. OF CITY OF CHICAGO

FIG. 2—Preliminary estimating unit selling prices (installed complete with renewable fuses) of 250-volt open distribution panels and cabinets.

3 W.—S.N. & 2 FUSES IN BRANCHES, POLARITY TYPE.

CAR. OF CTS.	30A.		60A.		LARGEST BRANCH CT. ON PANEL 100A.		200A.		400A.		600A.	
	MAT BASE PR.	SELL PR. INSTALLED	MAT BASE PR.	SELL PR. INSTALLED	MAT BASE PR.	SELL PR. INSTALLED	MAT BASE PR.	SELL PR. INSTALLED	MAT BASE PR.	SELL PR. INSTALLED	MAT BASE PR.	SELL PR. INSTALLED
30A	P 1.80 F .50	5.65	P 2.10 F .50	6.20	P 2.40 F .50	6.60	P 3.00 F .50	7.40	P 3.30 F .50	7.90	P 3.60 F .50	8.60
60A			P 2.40 F 1.00	8.15	P 3.00 F 1.00	9.05	P 3.60 F 1.00	9.90	P 4.20 F 1.00	10.80	P 4.50 F 1.00	11.50
100A					P 4.50 F 2.25	14.90	P 4.80 F 2.25	15.60	P 5.40 F 2.25	16.70	P 6.00 F 2.25	17.60
200A	USE COL. OF LARGEST CT. ON PANEL. P—DESIGNATES CONTRS' PUR. PRICE OF PANEL EQUIPMENT. F—DESIGNATES CONTRS' PUR. PRICE OF REN. FUSES.						P 6.30 F 5.00	22.40	P 6.90 F 5.00	23.60	P 7.80 F 5.00	25.00
400A									P 12.00 F 5.00	38.00	P 13.50 F 5.00	41.20
600A											P 24.00 F 13.60	63.00
ADD FOR	100A.		200A.		400A.		600A.		800A.		1200A.	
LUG MAINS & NEUTRAL BAR	P 18.60 —	28.00	P 22.20 —	35.00	P 36.60 —	55.00	P 47.40 —	72.00	P 61.80 —	95.00	P 83.20 —	131.00
FUSED MAINS & NEUTRAL BAR	P 22.60 F 2.25	35.75	P 28.60 F 5.00	49.00	P 49.80 F 9.00	81.00	P 67.40 F 13.60	110.50	P 87.90 F 18.00	147.00	P 119.20 F 27.20	205.00
NO. F. MAIN SWITCH & NEUTRAL BAR	P 28.90 —	40.00	P 33.00 —	48.40	P 60.80 —	83.00	P 83.40 —	113.00	P 110.80 —	154.00	P 142.20 —	200.00
FUSED MAIN SW. & NEUTRAL BAR	P 31.20 F 2.25	46.00	P 39.20 F 5.00	62.00	P 68.80 F 9.00	104.00	P 98.40 F 13.60	147.00	P 131.80 F 18.00	197.00	P 166.40 F 27.20	260.00
METER LOOPS	P 2.70 —	12.00	P 3.60 —	17.50	P 4.40 —	23.00	P 7.00 —	32.00	P 9.60 —	43.00	P 12.00 —	61.00

3 W.—S.N. & 2 P. FUSED SW. BRANCHES.

CAR. OF CTS.	30A.		60A.		LARGEST BRANCH CT. ON PANEL 100A.		200A.		400A.		600A.	
	MAT BASE PR.	SELL PR. INSTALLED	MAT BASE PR.	SELL PR. INSTALLED	MAT BASE PR.	SELL PR. INSTALLED	MAT BASE PR.	SELL PR. INSTALLED	MAT BASE PR.	SELL PR. INSTALLED	MAT BASE PR.	SELL PR. INSTALLED
30A.	P 6.00 F .50	10.70	P 6.60 F .50	11.40	P 7.50 F .50	12.60	P 8.10 F .50	13.40	P 9.00 F .50	14.60	P 9.90 F .50	15.80
60A.			P 8.40 F 1.00	15.20	P 9.60 F 1.00	16.70	P 10.80 F 1.00	18.30	P 12.00 F 1.00	19.80	P 13.20 F 1.00	21.40
100A.					P 13.20 F 2.25	25.40	P 15.00 F 2.25	27.80	P 16.80 F 2.25	30.20	P 18.60 F 2.25	33.00
200A.	USE COL. OF LARGEST CT. ON PANEL. P—DESIGNATES CONTRS' PUR. PRICE OF PANEL EQUIPMENT. F—DESIGNATES CONTRS' PUR. PRICE OF REN. FUSES.						P 19.20 F 5.00	41.60	P 21.60 F 5.00	45.00	P 24.00 F 5.00	48.50
400A.									P 36.00 F 9.00	66.50	P 38.40 F 9.00	70.00
600A.											P 55.80 F 13.60	99.00
ADD FOR	100A.		200A.		400A.		600A.		800A.		1200A.	
LUG MAINS & NEUTRAL BAR	P 30.60 —	41.30	P 36.20 —	51.00	P 54.40 —	75.00	P 74.00 —	101.00	P 94.00 —	131.00	P 119.00 —	171.00
FUSED MAINS & NEUTRAL BAR	P 36.20 F 2.25	51.00	P 47.40 F 5.00	70.00	P 76.40 F 9.00	111.00	P 106.50 F 13.60	154.00	P 139.00 F 18.00	204.00	P 180.40 F 27.20	273.00
NO. F. MAIN SWITCH & NEUTRAL BAR	P 40.70 —	53.00	P 50.20 —	68.00	P 84.90 —	110.00	P 118.00 —	151.00	P 152.00 —	198.00	P 193.40 —	256.00
FUSED MAIN SW. & NEUTRAL BAR	P 46.80 F 2.25	63.00	P 61.30 F 5.00	87.00	P 99.00 F 9.00	137.00	P 145.00 F 13.60	199.00	P 205.00 F 18.00	279.00	P 237.40 F 27.20	340.00
METER LOOPS	P 3.60 —	13.00	P 4.80 —	19.00	P 7.20 —	26.00	P 9.90 —	35.00	P 13.50 —	47.00	P 16.80 —	67.00

1—20% WAS ADDED TO INST. LABOR FOR INSURANCES, TOOLS, & OTHER DIRECT JOB COSTS.

2—MARKUPS USED { MATERIAL—10% FOR GEN. OVERHEAD & RETURN.
LABOR — 15% FOR GEN. OVERHEAD & 10% FOR RETURN.

3—VACANT SPACES ARE FOR CONTRACTOR'S ADJUSTED PRICES.

4—BR. CT. UNITS INCL. COST OF LAB. FOR CONN. TO NEUT. BAR

ELECTRICAL CONTRACTORS' ASSN. OF CITY OF CHICAGO.

FIG. 3—Open front, 125/250-volt distribution panel and cabinet selling prices (completely installed) for preliminary estimating purposes.

UNITS FOR PRELIM FIELD ESTIMATING		250V. DIST. PANELS & CABINETS (OPEN FRONT)										SHEET 3	
		EST. SELL PRICE - INSTALLED COMPL., INCLUDING REN. FUSES.										LAB. RATE 1.70/HR. SEE NOTES	
3W, 3PHASE, POLARITY TYPE (FUSES ONLY IN BR.)													
CAP OF CTS.	30A.		60A.		100A.		200A.		400A.		600A.		
	MAT. BASE PR	SELL PR. INSTALLED	MAT. BASE PR	SELL PR. INSTALLED	MAT. BASE PR	SELL PR. INSTALLED	MAT. BASE PR	SELL PR. INSTALLED	MAT. BASE PR	SELL PR. INSTALLED	MAT. BASE PR	SELL PR. INSTALLED	
30A.	P 2.40 F .75	6.60	P 3.30 F .75	7.70	P 3.90 F .75	8.50	P 4.80 F .75	9.70	P 5.10 F .75	10.30	P 6.00 F .75	11.40	
60A.			P 3.90 F 1.50	10.30	P 5.10 F 1.50	11.85	P 5.70 F 1.50	12.60	P 6.90 F 1.50	14.25	P 7.20 F 1.50	14.70	
100A.					P 6.90 F 3.35	18.70	P 7.80 F 3.35	20.00	P 8.40 F 3.35	21.00	P 9.60 F 3.35	22.80	
200A.	USE COL. OF LARGEST CT. ON PANEL P-DESIGNATES CONTRS' PUR. PRICE OF PANEL EQUIPMENT REN. FUSES						P 9.60 F 7.50	29.00	P 10.50 F 7.50	30.30	P 11.40 F 7.50	31.70	
400A.									P 18.00 F 13.50	49.60	P 19.00 F 13.50	51.50	
600A.											P 35.00 F 20.40	81.50	
ADD FOR	100A.		200A.		400A.		600A.		800A.		1200A.		
LUG MAINS	P 13.80 —	22.80	P 22.20 —	35.00	P 28.50 —	46.50	P 38.00 —	61.50	P 47.50 —	79.50	P 66.00 —	112.00	
FUSED MAINS	P 18.00 F 3.25	33.00	P 24.00 F 7.50	47.00	P 42.00 F 13.50	78.00	P 59.00 F 20.40	110.00	P 80.00 F 27.00	148.00	P 112.00 F 40.80	212.00	
NO F. MAIN SWITCH	P 25.00 —	36.00	P 30.00 —	46.00	P 58.00 —	80.00	P 83.40 —	114.00	P 110.00 —	151.00	P 145.00 —	204.00	
FUSED MAIN SW.	P 29.40 F 3.35	45.00	P 37.50 F 7.50	63.00	P 67.00 F 13.50	107.00	P 100.00 F 20.40	156.00	P 137.00 F 27.00	212.00	P 176.00 F 40.80	287.00	
METER LOOPS	P 2.70 —	12.10	P 3.60 —	17.40	P 5.40 —	24.00	P 7.20 —	32.00	P 10.00 —	44.00	P 12.80 —	62.00	
3W, 3PHASE - FUSED SWITCH BR.													
CAP OF CTS.	30A.		60A.		100A.		200A.		400A.		600A.		
	MAT. BASE PR	SELL PR. INSTALLED	MAT. BASE PR	SELL PR. INSTALLED	MAT. BASE PR	SELL PR. INSTALLED	MAT. BASE PR	SELL PR. INSTALLED	MAT. BASE PR	SELL PR. INSTALLED	MAT. BASE PR	SELL PR. INSTALLED	
30A.	P 9.00 F .75	14.20	P 9.90 F .75	15.30	P 11.40 F .75	17.20	P 12.30 F .75	18.50	P 14.10 F .75	20.65	P 15.00 F .75	21.70	
60A.			P 12.60 F 1.50	20.20	P 14.40 F 1.50	22.70	P 16.20 F 1.50	24.80	P 18.00 F 1.50	27.20	P 19.80 F 1.50	29.40	
100A.					P 21.00 F 3.35	35.00	P 23.40 F 3.35	38.20	P 25.80 F 3.35	41.40	P 28.20 F 3.35	44.60	
200A.	USE COL. OF LARGEST CT. ON PANEL. P-DESIGNATES CONTRS' PUR. PRICE OF PANEL EQUIPMENT. REN. FUSES						P 30.00 F 7.50	52.50	P 32.50 F 7.50	55.60	P 36.00 F 7.50	60.00	
400A.									P 54.00 F 13.50	91.00	P 57.80 F 13.50	98.60	
600A.											P 81.60 F 20.40	136.00	
ADD FOR	100A.		200A.		400A.		600A.		800A.		1200A.		
LUG MAINS	P 24.00 —	34.00	P 27.00 —	40.50	P 44.00 —	64.00	P 61.20 —	87.00	P 76.80 —	112.00	P 99.00 —	148.00	
FUSED MAINS	P 33.00 F 3.25	48.25	P 42.00 F 7.50	67.00	P 69.00 F 13.50	108.00	P 97.00 F 20.40	153.00	P 131.00 F 27.00	204.00	P 175.00 F 40.80	281.00	
NO F. MAIN SWITCH	P 36.00 —	48.00	P 45.00 —	62.50	P 80.00 —	105.00	P 117.00 —	152.00	P 154.00 —	200.00	P 196.00 —	268.00	
FUSED MAIN SW.	P 46.40 F 3.25	64.00	P 59.50 F 7.50	87.00	P 98.40 F 13.50	142.00	P 146.00 F 20.40	207.00	P 192.00 F 27.00	275.00	P 255.00 F 40.80	374.00	
METER LOOPS	P 3.60 —	13.00	P 4.50 —	18.50	P 7.20 —	26.00	P 9.90 —	34.00	P 13.50 —	48.00	P 16.20 —	62.00	
1 - 20% WAS ADDED TO INST. LABOR FOR INSURANCES, TOOLS, & OTHER DIRECT JOB COSTS. 2 - MARK UPS USED MATERIAL - 10% FOR GEN. OVERHEAD & RETURN. LABOR - 15% FOR GEN. OVERHEAD & 10% FOR RETURN. 3 - VACANT SPACES ARE FOR CONTRACTORS' ADJUSTED PRICES.													
NOTES													

FIG. 4—Three-wire, 3-phase, 250-volt open front distribution panel and cabinet estimated installed selling price. 5-Op

UNITS FOR PRELIM.
FIELD ESTIMATING

600 VOLT DIST. PANELS & CABINETS (OPEN FRONT)

SHEET 4.

EST. SELL PRICES—INSTALLED COMPL., INCLUDING REN. FUSES. LAB. RATE 1.70/HR. SEE NOTES

3W, 3 PHASE, POLARITY TYPE (FUSES ONLY IN BR.)

CAP. OF CTS.	30 A.		60 A.		LARGEST BRANCH CT. ON PANEL 100 A.		200 A.		400 A.		600 A.	
	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED
30 A.	P 5.10 F 1.95	11.50	P 5.70 F 1.95	12.30	P 6.30 F 1.95	13.10	P 7.20 F 1.95	14.30	P 8.50 F 1.95	15.80		
60 A.			P 6.60 F 3.00	15.80	P 7.80 F 3.00	17.30	P 8.70 F 3.00	18.50	P 10.20 F 3.00	20.00		
100 A.					P 9.90 F 6.75	27.00	P 11.40 F 6.75	29.50	P 12.30 F 6.75	31.00		
200 A.	USE COL. OF LARGEST CT. ON PANEL P—DESIGNATES CONTRS. PUR. PRICE OF PANEL EQUIPMENT. F—DESIGNATES CONTRS. PUR. PRICE OF REN. FUSES.						P 13.80 F 13.00	41.50	P 15.00 F 13.00	43.00		
400 A.									P 23.20 F 26.00	71.00		
600 A.												
ADD FOR	100 A.		200 A.		400 A.		600 A.		800 A.		1200 A.	
LUG MAINS	P 16.80 —	28.00	P 24.00 —	40.00	P 32.00 —	54.00	P 43.00 —	71.50	P 55.00 —	95.00	P 71.00 —	127.00
FUSED MAINS	P 22.80 F 6.75	44.00	P 30.00 F 13.00	62.50	P 49.00 F 26.00	105.00	P 69.00 F 37.50	147.00	P 92.00 F 52.00	200.00	P 125.00 F 75.00	278.00
NO F. MAIN SWITCH	P 27.00 —	41.50	P 36.00 —	55.00	P 62.50 —	91.00	P 87.00 —	126.00	P 114.00 —	160.00	P 158.00 —	235.00
FUSED MAIN SW.	P 32.40 F 6.75	56.00	P 42.50 F 13.00	78.00	P 83.00 F 26.00	145.00	P 104.00 F 37.50	188.00	P 142.00 F 52.00	260.00	P 184.00 F 75.00	350.00
METER LOOPS												

3W, 3 PHASE—FUSED SW. BRANCHES.

CAP. OF CTS.	30 A.		60 A.		LARGEST BRANCH CT. ON PANEL 100 A.		200 A.		400 A.		600 A.	
	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED
30 A.	P 9.60 F 1.95	16.80	P 10.50 F 1.95	18.00	P 12.00 F 1.95	19.80	P 13.20 F 1.95	21.50	P 15.00 F 1.95	23.40		
60 A.			P 13.60 F 3.00	24.00	P 15.30 F 3.00	26.00	P 17.50 F 3.00	28.50	P 19.20 F 3.00	31.00		
100 A.					P 22.10 F 6.75	41.50	P 25.00 F 6.75	45.00	P 27.60 F 6.75	48.50		
200 A.	USE COL. OF LARGEST CT. ON PANEL P—DESIGNATES CONTRS. PUR. PRICE OF PANEL EQUIPMENT. F—DESIGNATES CONTRS. PUR. PRICE OF REN. FUSES.						P 32.00 F 13.00	63.00	P 34.60 F 13.00	67.00		
400 A.									P 57.00 F 26.00	116.00		
600 A.												
ADD FOR	100 A.		200 A.		400 A.		600 A.		800 A.		1200 A.	
LUG MAINS	P 26.00 —	38.00	P 36.00 —	52.00	P 48.00 —	71.00	P 66.60 —	98.00	P 83.00 —	126.00	P 107.00 —	166.00
FUSED MAINS	P 35.50 F 6.75	58.00	P 46.00 F 13.00	80.00	P 75.00 F 26.00	133.00	P 105.00 F 37.50	186.00	P 143.00 F 52.00	256.00	P 192.00 F 75.00	350.00
NO F. MAIN SWITCH	P 39.00 —	55.00	P 48.60 —	69.00	P 88.00 —	119.00	P 127.00 —	169.00	P 167.00 —	224.00	P 213.00 —	292.00
FUSED MAIN SW.	P 50.00 F 6.75	75.00	P 64.00 F 13.00	100.00	P 107.00 F 26.00	170.00	P 159.00 F 37.50	250.00	P 208.00 F 52.00	334.00	P 272.00 F 75.00	445.00
METER LOOPS												

- NOTES
- 1- 20% WAS ADDED TO INST. LABOR FOR INSURANCES, TOOLS, & OTHER DIRECT JOB COSTS.
 - 2- MARKUPS USED MATERIAL—10% FOR GEN. OVERHEAD & RETURN.
LABOR — 15% FOR GEN. OVERHEAD & 10% FOR RETURN.
 - 3- VACANT SPACES ARE FOR CONTRACTOR'S ADJUSTED PRICES

ELECTRICAL CONTRACTORS' ASS'N. OF CITY OF CHICAGO

IC. 5—Open front, 600-volt distribution cabin panel estimated installed selling prices.

UNITS FOR PRELIM.
FIELD ESTIMATING.

DEAD FRONT (PULL OUT TYPE) PANELBOARDS EST. SELL PRICE-INSTALLED COMPL., INCLUDING REN. FUSES.

LAB. RATE 1.70/HR.

SHEET 3
SEE NOTES

250 VOLT, 3W, 3 PHASE MAINS

MAX. MAIN OR BR. UNIT CAP.	TYPE OF MAIN	MAIN BUS CAPACITY											
		100 A.		200A.		400A.		600A.		800A.		1200A.	
		MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED
100A. & UNDER	LUGS ONLY	P 5.50	14.40	P 5.50	18.15	P 11.00	29.00	P 22.00	47.00	P 44.00	78.50	P 68.75	172.00
	PULL OUT UNIT	P 20.35 F 3.35	35.20	P 45.65 F 7.50	72.00	P 108.00 F 13.50	154.00	P 165.00 F 20.40	228.00				
200A. & UNDER	LUGS ONLY			P 11.00	25.00	P 16.50	36.00	P 27.50	54.00	P 44.00	79.00	P 68.75	172.00
	PULL OUT UNIT			P 45.65 F 7.50	73.00	P 108.00 F 13.50	155.00	P 165.00 F 20.40	229.00				
400A. & UNDER	LUGS ONLY					P 27.50	49.00	P 38.50	67.00	P 60.30	99.00	P 82.50	164.00
	PULL OUT UNIT	P-DESIGNATES CONTRS. PUR. PR. OF PANEL, EQ. F-... REN. FUSES				P 108.00 F 13.50	156.00	P 165.00 F 20.40	230.00				
600A. & UNDER	LUGS ONLY							P 49.50	82.00	P 82.50	124.00	P 104.50	161.00
	PULL OUT UNIT							P 165.00 F 20.40	231.00				

250 VOLT, 3W, 3 PHASE, BRANCH CIRCUITS

	30A-30A.		60A-60A.		100A-100A.		100A.		200A.		400 A.		600A.	
	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED
DOUBLE BR. 2 CIRCUITS	P 9.30 F 1.50	19.70	P 18.15 F 3.00	34.00	P 29.70 F 6.70	59.00								
SINGLE BR. 1 CIRCUIT							P 14.85 F 3.50	29.50	P 34.65 F 7.50	59.00	P 80.30 F 13.50	122.00	P 115.50 F 20.40	172.00
SPACE ONLY FOR SECTION	P 3.20	6.50	P 6.30	11.00	P 9.20	16.50	P 9.20	14.00	P 9.20	15.00	P 14.00	23.00	P 31.00	42.00

600 VOLT, 3W, 3 PHASE MAINS.

MAX. MAIN OR BR. UNIT CAP.	TYPE OF MAIN	MAIN BUS CAPACITY											
		100A.		200A.		400A.		600A.		800A.		1200A.	
		MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED
100A. & UNDER	LUGS ONLY	P 20.35	32.00	P 20.35	35.00	P 25.85	47.00	P 37.00	65.00	P 51.20	91.00	P 75.50	172.00
	PULL OUT UNIT	P 46.25 F 6.75	71.50	P 72.60 F 13.00	110.00	P 142.50 F 26.00	206.00						
200A. & UNDER	LUGS ONLY			P 20.35	36.00	P 25.85	48.00	P 37.00	66.00	P 51.20	93.00	P 75.50	172.00
	PULL OUT UNIT			P 72.60 F 13.00	112.00	P 142.50 F 26.00	207.00						
400A. & UNDER	LUGS ONLY					P 38.00	62.00	P 48.00	80.00	P 68.20	115.00	P 89.00	141.00
	PULL OUT UNIT					P 142.50 F 26.00	210.00						
600A. & UNDER	LUGS ONLY							P 55.00	89.00	P 89.00	139.00	P 110.00	172.00

600 VOLT, 3W, 3 PHASE, BRANCH CIRCUITS

	30A-30A.		60A-60A.		100A.		200A.		400A.		600A.	
	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED	MAT. BASE PR.	SELL PR. INSTALLED
DOUBLE BR.-2 CIRCUITS	P 26.40 F 3.90	42.00	P 26.40 F 6.00	48.50								
SINGLE BR - 1 CIRCUIT					P 26.40 F 6.75	47.00	P 52.00 F 13.00	86.00	P 104.50 F 26.00	165.00		
SPACE ONLY FOR SECTIONS	P 9.20	13.25	P 9.20	13.75	P 9.20	14.00	P 14.10	21.00	P 31.00	42.50		

- NOTES
- 1-20% WAS ADDED TO INST. LABOR FOR INSURANCES, TOOLS, & OTHER DIRECT JOB COSTS.
 - 2-MARKUPS USED MATERIAL-10% FOR GEN. OVERHEAD & RETURN.
LABOR - 15% FOR GEN. OVERHEAD & 10% FOR RETURN.
 - 3-VACANT SPACES ARE FOR CONTRACTOR'S ADJUSTED PRICES.

ELECTRICAL CONTRACTOR'S ASS'N. OF CITY OF CHICAGO

FIG. 6—Dead front (pull-out type) panelboard estimated installed selling prices for 250-volt and 600-volt units.

COMMUTATOR BRUSH MAINTENANCE

Proper spring compression and properties of brush materials are important factors in preventing undue brush wear, and in transferring current efficiently

By D. E. Stafford

Asst. Chief Engineer National Electric Coil Co., Columbus, O.

THE importance of correct spring compression on the brushes which conduct the current to and from the rotating element of electrical apparatus cannot be over-emphasized.

In addition, the material of which

the brush is made must be neither so soft that it wears away rapidly nor so hard that it wears or scores the commutator, or collector ring surface. Furthermore, brushes used on commutators must have precise resistance characteristics to minimize the sparking which is so detrimental to the brush as well as to the surface of the commutator.

The essential requirements for efficient transfer of current to and from the rotor of electrical apparatus are (1) proper brush grade; (2) maximum and continuous brush surface contact on the commutator; (3) brush holders of proper dimensions set to the correct angle with respect to the commutator surface; (4) brush holder arms equally spaced around the periphery of the commutator; (5) adjustment for correct neutral setting; (6) dynamic balancing of rotor; (7) correct and uniform spring pressure, an important precaution which is frequently overlooked.

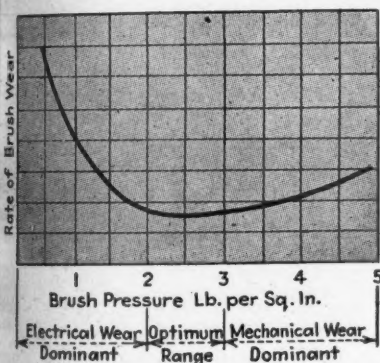


Fig. 1—Graph of the rate of wear of an electro-graphite brush with various spring pressures. For each composition of brush there is a certain pressure range where maximum wearing life in service will prevail.

BRUSH MATERIAL	PRESSURE IN LBS. PER SQ. INCH	
	Industrial Service	Railway Service
CARBON & CARBON GRAPHITE.....	1½-2½	
ELECTRO-GRAPHITE.....	2-3¼	5-7
GRAPHITE, SOFT.....	1¼-2¼	
GRAPHITE, HARD.....	3-4	
METAL GRAPHITE ON COMMUTATORS....	2½-3½	
METAL GRAPHITE ON SLIP RINGS.....	3-4	

Fig. 2—Table showing spring pressures for brushes of various compositions. In the absence of exact data as to the brush composition, a pressure of 2 lbs. per square inch may be used for most industrial applications.

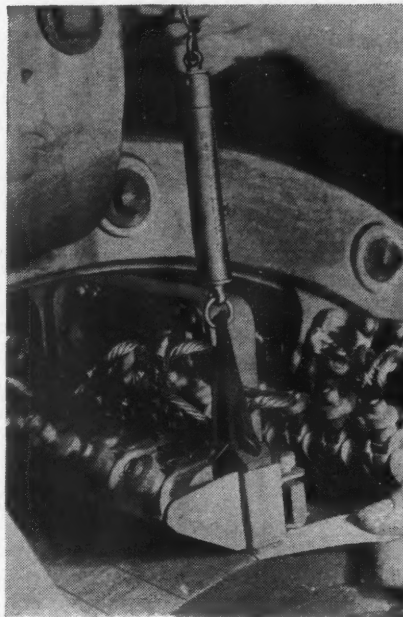


Fig. 3—Brush tension scale being used to check spring pressure on a plating generator brush holder. The operator is using a paper slider to enable him to feel the tension where the brush is lifted from the commutator. Where multiple brushes are used, it is important that each brush be operated with the proper tension to minimize selective action and to secure maximum economical life of brushes and commutator surface.

Each grade of brush should always be operated within a certain definite range of pressures. A disregard of this range causes rapid wear of the brush or scoring or burning of the commutator. A curve illustrating this characteristic for one particular grade of brush is shown in Fig. 1. All brushes on a commutator or collector ring should be operated at equal pressure to avoid selective action or unequal current distribution.

Operators should be guided at all times by the recommendations of manufacturers of the equipment and the brushes as indicated in the table of Fig. 2.

The pressure values given in the table must be multiplied by the area of the bearing surface of the brush in square inches to find total pressure.

BRIEF ARTICLES about practical methods of installation and maintaining electrical wiring and equipment and up-to-date estimating and office practices. Readers are invited to contribute items from their experience to this department. All articles used will be paid for.

PRACTICAL METHODS

COOLED CRANE CAB FOR OPERATOR COMFORT

INDUSTRIAL

It can get awfully hot in an open crane cab operating over the furnaces in a forge shop—particularly in mid-summer when the temperatures of the atmosphere over the furnaces may be 70 to 80 degrees higher than outdoor temperatures. In the heavy forge shop of the Dodge-Chicago Plant, Division of the Chrysler Corporation, where B-29 engines were produced, indoor temperatures at crane level were as high as 170 to 180 degrees (outdoor temp., 99 to 100 degrees). A man can't work very long in such an atmosphere and relief operators had to take over at frequent intervals.

To increase the comfort and efficiency of the crane operators, the plant engineering department air-conditioned the cab of the 20-ton bridge crane that operated over the furnace areas. Result: With a shop temperature of 180 degrees (outdoor, 99 degrees), the cab temperature was lowered to about 102 degrees; with a shop temperature of 150 degrees (outdoor, 80) cab temperature was 70 degrees.

The air conditioning system was a simple two-stage water cooling unit mounted on top of an enclosed cab (See Figs. 1 and 2). Water from a storage tank at the bottom of the unit is pumped to the cooling coils of the air cooling section where the entering air is pulled in by a blower through a filter grille. The hot air passes over the cooling coils, through an evaporator mat and is forced, at a considerably reduced temperature, into the crane cab through a supply duct.

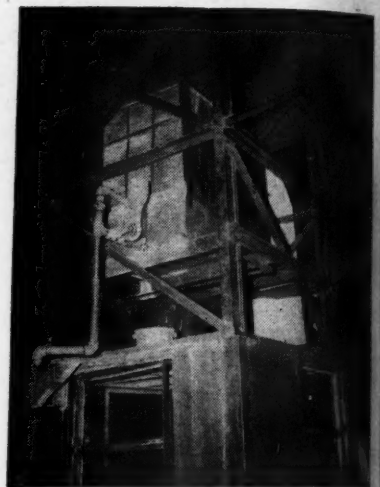
The water from the cooling coil passes over five layers of decking where it is cooled by forced air and finally returns to the storage tank where the recirculating process is repeated. Overflow from the sump of the evaporator mat also returns to the storage tank. One filling of the water tank was usually sufficient for an 8-hour shift operation.

The crane cab (5 ft.-6 in. square

by 6 ft. high) was totally enclosed with double sheet steel and double glass panels. The sheet steel panels are equipped with 2-inches of insulation, the floor with 3 inches. The double glass panels have a $\frac{1}{4}$ -inch dead air space as the insulating medium. Several of the glass panels are on a swinging sash so they can be opened when the cooling unit is not in use in winter months.

A 12-inch wide overhang with a

Compact cooling unit is mounted directly above the cab. Insulated supply duct directs cool air into cab. One filling of water reservoir was sufficient for an 8-hour shift operation.



Air-cooled crane cab in heavy forge shop at Chrysler operated Dodge Chicago plant provides about an 80 degree temperature reduction for operator. Note insulated steel and double glass panels totally enclosing the cab.

SYLVANIA NEWS

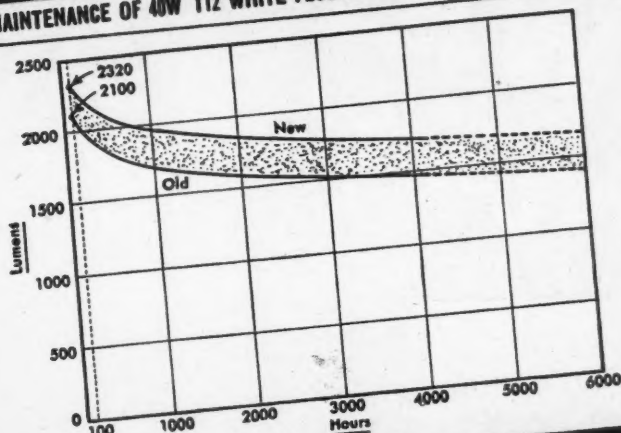
CONTRACTOR EDITION

DEC. Published by SYLVANIA ELECTRIC PRODUCTS INC., Salem, Mass.

1945

NEW EFFICIENCY RATINGS OF 20-W, 40-W FLUORESCENT LAMPS ANNOUNCED BY SYLVANIA

LUMEN MAINTENANCE OF 40W T12 WHITE FLUORESCENT LAMPS ON 12-HOUR CYCLE



NEW FLUORESCENT RATINGS

	100 Hr. LPW		Maintenance at 70%	
	Old	New	Old	New
20W T12 White	43	46	36	39
			32.5	35.5
			30	33
20W T12 Daylight	38	—	32	32
			29	31.5
			26.5	30
40W T12 White	52	58	43.5	50
			39.5	46
			36.5	43
40W T12 Daylight	45	—	38	40
			34	37
			31.5	34

Through extensive research and further improvement in manufacturing methods, Sylvania Electric has made available *more light* from their popular 20-watt and 40-watt fluorescent lamps.

For contractors this means giving further impetus toward the installation of fluorescent lighting to a greater extent than ever before.

These increases have been accomplished by Sylvania without any change in some physical or technical characteristic of the lamps. And they entail no additional cost to purchasers!

The above curves show new and old lumen ratings (at 100 hours) and the lumen maintenance throughout life when lamp is operated on 12 hour cycle.

Prior to May 21st of this year the 40-watt White fluorescent lamp was rated at 52.5 lumens per watt. New rating represents an increase of 11.5% over the lumen rating which was effective until May 21st. While the lumen *maintenance* rating of the 20-watt Daylight lamp, on a 12 hour operating cycle at 70% life, has been increased 15.4%.

SYLVANIA ELECTRIC

MAKERS OF FLUORESCENT LAMPS, FIXTURES, WIRING DEVICES; ELECTRIC LIGHT BULBS; RADIO TUBES; CATHODE RAY TUBES; ELECTRONIC DEVICES

Electrical Contracting, December 1945

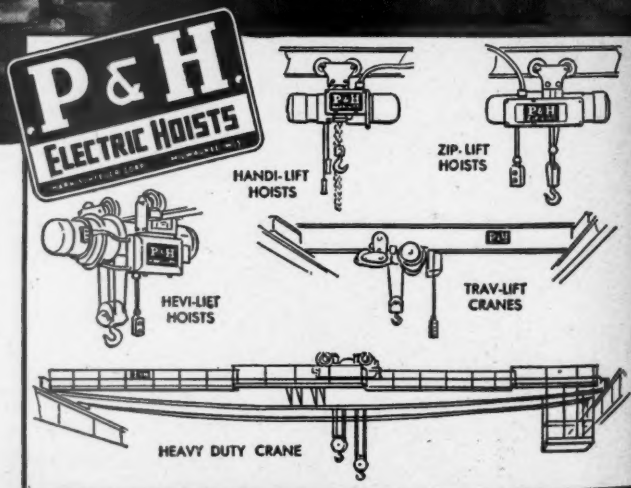


**THERE'S ONLY
ONE WAY
TO Lower Costs!**

Nowadays, there's only one sure way to lower costs—more production per man-hour! And "thru-the-air" materials handling is a proved method of freeing skilled hands from unproductive work.

Take the P&H Zip-Lift. With this modern wire-rope hoist, your production man never wastes his energy—or skill—on load-lifting. He just presses buttons . . . and his loads are carried, lifted, lowered and placed with smooth, fast efficiency. Traveling "thru-the-air," they move direct, without congesting aisles.

Many of your materials can move with this same economy—from raw to finished state—and without costly rehandling. It's this speed and ease which have enabled Zip-Lifts to pay for themselves twice over in a single year. Let them work to lower your costs! Ask a P&H Hoist Engineer to look over your handling needs . . . or write us for Bulletin H20-2.



P & H

HARNISCHFEGER

CORPORATION

HOISTS • WELDING ELECTRODES • MOTORS EXCAVATORS • ELECTRIC CRANES • ARC WELDERS

ELECTRIC HOISTS

4426 W National Avenue,
Milwaukee 14, Wis.

FIG. 2
lated
provi

FIG. 2—
fixed gla
the front
operator
curately
one of th
The c
through

Electric

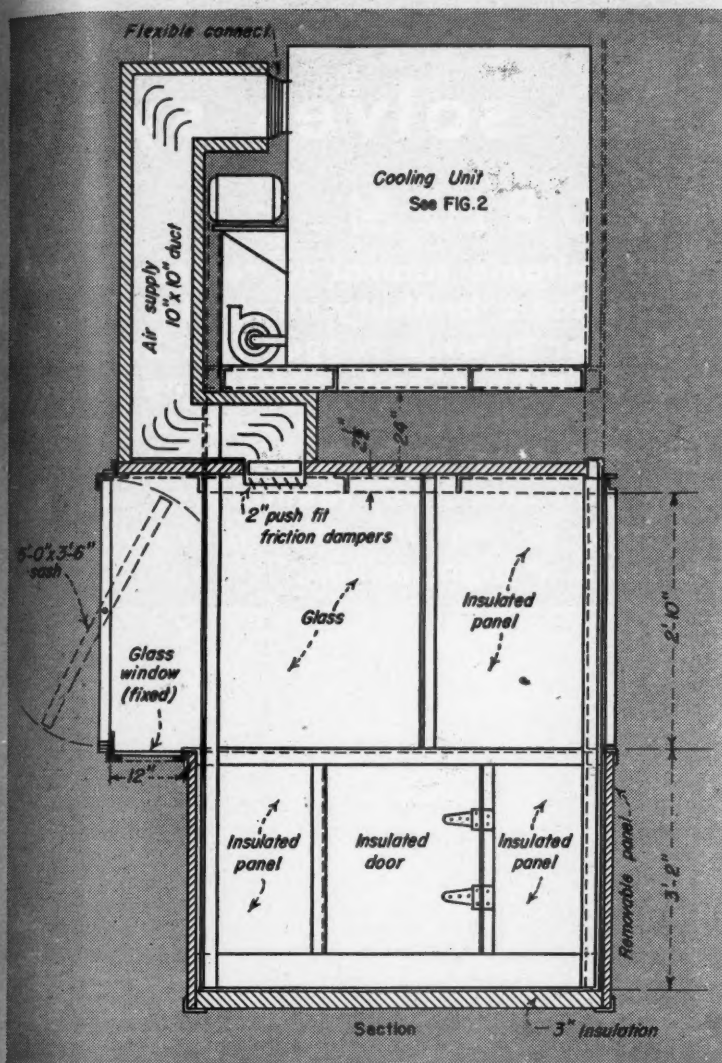


FIG. 1—Details of crane cab enclosure construction showing the insulated steel and double glass panels. Note glass enclosed overhang to provide clear view of shop to operator.

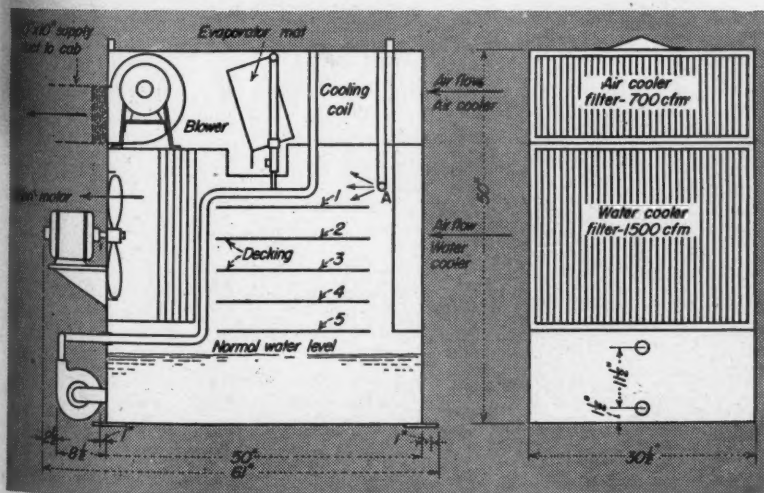


FIG. 2—Sectional view of cooling unit showing water and air cooling process.

fixed glass panel bottom extends over the front of the cab. This permits the operator to see the crane hook and accurately spot the loads without opening one of the insulated window panels. The cool air enters the crane cab through a 10-in. by 10-in. insulated

supply duct and a push-fit friction damper grille. The slight positive pressure maintained by this incoming air is sufficient to prevent the hot exterior gases from entering the cab. There is sufficient "leakage" in the cab construction to permit air circula-

tion without building up uncomfortable pressures.

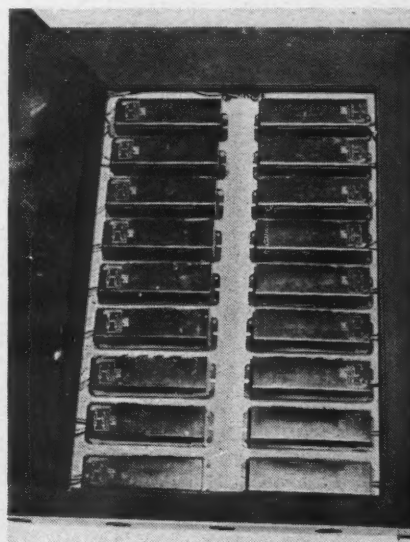
This air cooled crane cab added materially to the efficiency of the forge shop operations, reducing the number of relief crews necessary and immeasurably improving the working conditions of the crane operators.

COLD CATHODE BALLASTS MOUNTED IN REMOTE PANEL

WIRING

There has been a general reluctance to consider the installation of fluorescent ballasts any appreciable distance from the fixtures or lamps which they serve, primarily because of the electrical losses that might be incurred. This has been particularly true with high-voltage cold cathode fluorescent installations where excessive capacity losses in the cable are encountered. Such losses are always directly proportional to the voltage either between the conductors or from any high-tension conductor to ground. On the average 12,000- or 15,000-volt installations, cable runs were generally limited to 10 or 15 feet.

The newly developed 750-volt cold cathode lighting, however, permits longer cable runs. Tests made by the General Luminescent Corporation engineers at Chicago, prior to a "low-voltage" cold cathode lighting installation at the Northwest Airlines office in that city, indicated that with the 750-volt ballasts there was a minimum of loss due to the necessary length (up to 50 ft.) of the high voltage cable runs. With tests made at distances up to 85

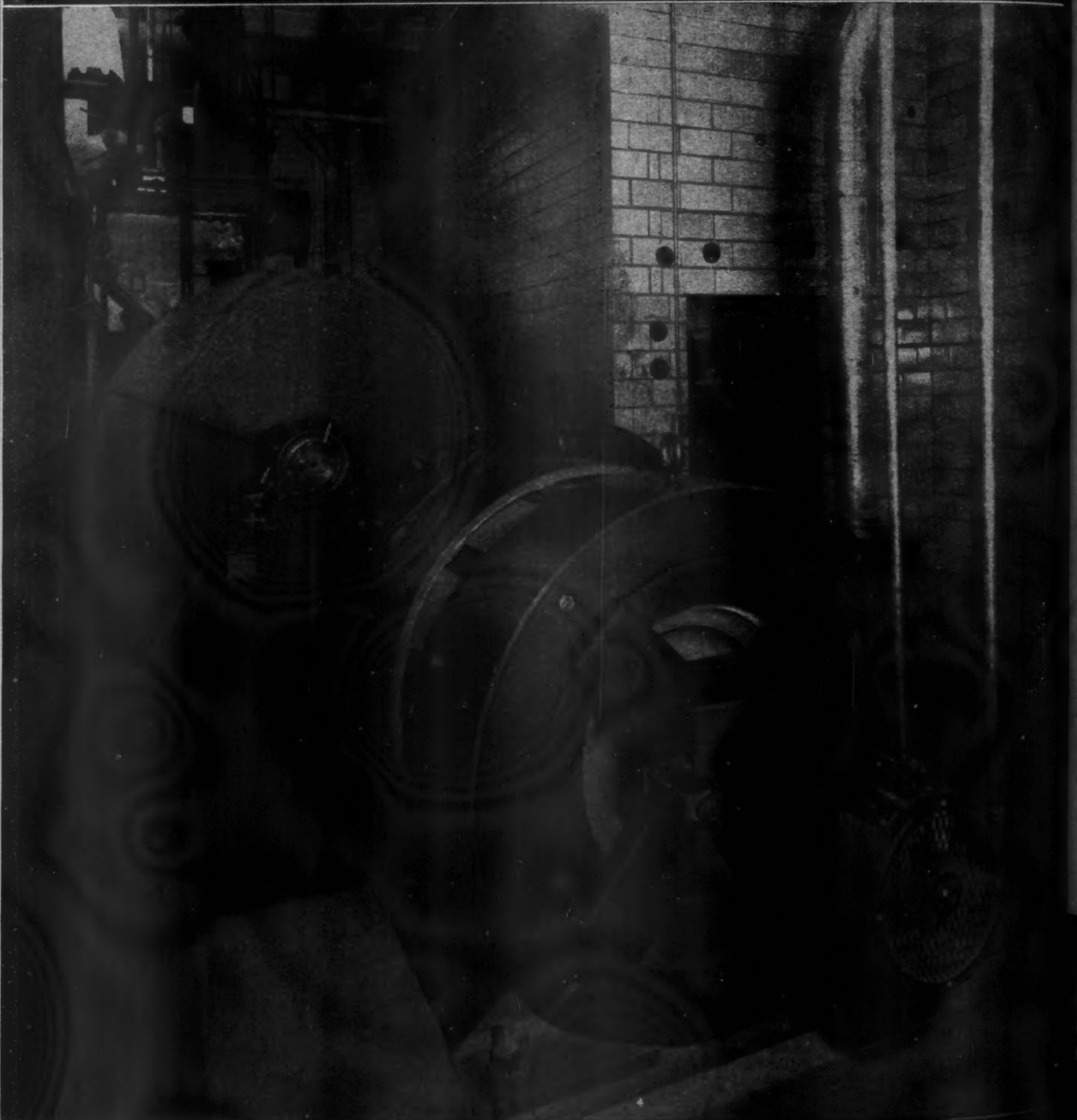


Remote ballast installation for the 750-volt cold cathode lighting at Northwest Airlines' Chicago office. Vent holes in top and bottom of cabinet provide adequate air circulation for dissipating heat.

BURKE solves synthetic rubber

THE PROBLEM...

To furnish an electric motor and suitable control to replace a 300 HP, 1200 RPM, Synchronous Motor, driving a banbury mixer, for the purpose of obtaining adjustable speed over a wide range. This banbury was originally installed to process crude rubber, and in changing over to the use of synthetic rubber, it was found that batch after batch of rubber and materials were burned up during the mixing process. Experiment and research proved that a slower mixing speed was required, or even better, a range of speeds of about 4 to 1, so that the mixing process could be started at slow speed and completed at high speed.



TH
A
problem
was sim
300 HP
HP dir
speed r
field co
howeve
rent po
type of

It was
suggest
speed a
high sp
tance, a
tion mo
applicat
manded
1200/9
4 speed
squirrel
high pu
the sha
with a f
type st
speed, a
and cor
saving i
current
the nec
current
plant an
solved t

The sel
cage in
means
duced a
to the d
and that
control
acceler
while op
out cau
the pow
mechan

The stan
availabl
vide the
Burke, in
Control
of Clev

MOT
B
BUR

the rubber processing problem

THE SOLUTION...

ATTER a preliminary survey of the problem, it was thought the solution was simply a matter of applying a 300 HP adjustable speed, tapered HP direct current motor, having a speed range of 400 to 1200 RPM by field control. Further study revealed, however, that sufficient direct current power was not available for this type of driving motor.

It was here that Burke Engineers suggested that as long as continuous speed adjustment from low speed to high speed was not of prime importance, a 4 speed squirrel cage induction motor would be ideal for the application. Burke Engineers recommended the purchase of a 300 HP, 1200/900/600/450 RPM, 2300 volt, 4 speed, 2 winding, constant torque, squirrel cage induction motor, having high pull out torque for overcoming the sharp peak loads, and complete with a fully magnetic, across-the-line type starter. The selection of a 4 speed, squirrel cage, induction motor and control effected a considerable saving in initial cost over the direct current motor and control, eliminated the necessity of increasing the direct current generating capacity of the plant and above all still satisfactorily solved the perplexing problem.

The selection of a 4 speed squirrel cage induction motor, as a driving means for the banbury mixer introduced another problem not common to the direct current driving motor, and that problem was finding suitable control equipment to automatically accelerate and decelerate the motor while operating under full load, without causing serious disturbance to the power system, or imposing severe mechanical strain on the motor.

The standard listed control equipment available on the market did not provide the desired characteristics so, Burke, in conjunction with the Electric Controller Manufacturing Company, of Cleveland, Ohio, worked out a

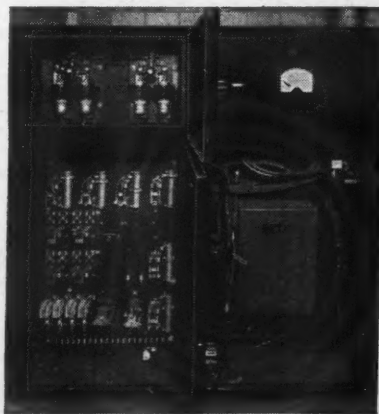
special fully magnetic controller, built around frequency sensitive relays, instead of time delay relays, to provide the automatic acceleration and deceleration. The varying frequency power to operate the relays of the starter being obtained from a frequency generator, directly connected to the main motor, so that its output frequency varied directly as the speed of the main motor. Each relay being adjusted to operate at a frequency corresponding to a certain motor speed. This controller is operated from a five position master station, mounted on the banbury mixer, convenient to the operator. The control functions so that irrespective of the speed selected by the operator, the motor always starts across-the-line on the low speed winding and accelerates progressively to the speed desired. If 1200 RPM is selected, the motor starts on the 450 RPM winding and accelerates to 440 RPM, at which point a frequency relay operates to energize the contactors connecting the 600 RPM winding to the line. As the motor speed reaches 590 RPM another frequency relay operates to energize the contactors connecting the 900 RPM winding to the line. When the motor reaches 890 RPM, still another frequency relay operates, energizing the contactors connecting the 1200 RPM high speed winding to the line. In this way the motor starts with a minimum of starting current and accelerates smoothly to the selected speed, with the least possible delay and with the transfer from one speed to another being made at exactly the proper instant to minimize the mechanical shock to the motor and disturbance to the power system.

In decelerating, or changing from a higher to a lower speed winding, it is extremely important to eliminate entirely the possibility of the power being thrown on the lower speed winding before the motor has decel-

erated to the speed selected. The complicating factor in deceleration cycle, was the fact that the time of deceleration varied considerably, depending on the magnitude of the load of the motor and the lower speed selected, so that a time delay relay for controlling the deceleration operation would be entirely out of the question. In changing from a higher to a lower speed winding, for example, from 1200 RPM to 450 RPM this being the extreme case, the operator would move the master switch from the high position to low position and the motor would be disconnected from the line and allowed to decelerate. Then, when the speed of the motor dropped to 450 RPM, a frequency relay would operate, energizing the contactors supplying power to the 450 RPM winding. In this way the motor would be thrown on the line again at exactly synchronous speed, eliminating any possibility of connection above synchronous speed, causing severe regenerative effects, or connection below synchronous speed, causing high current peaks in pulling the motor up to speed again.

Send your special motor or generator problem to . . . Burke Engineers . . . Write for Burke general catalog.

BURKE ELECTRIC CO.
13512 West 12th Street
ERIE, PENNSYLVANIA

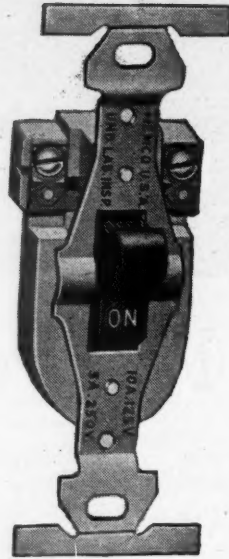


MOTORS 1 TO 1500 H. P. • GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • Since 1891

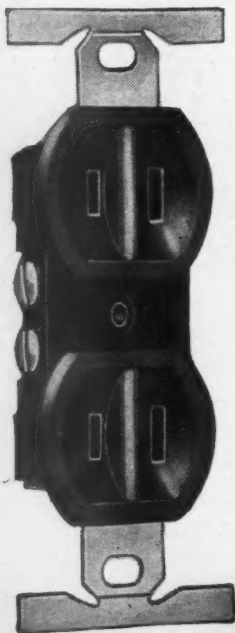
Wide mounting yoke permits correct alignment with wall surface.
Ample screw heads make wiring easy.
Tough porcelain cup.
Strong plastic handle.
Available with brown or ivory handle.
Single-Pole or 3-way action. Approved by Underwriters' Laboratories.



BRYANT FLUSH SWITCHES No. 51 and No. 53

Announcing...

NEW DESIGNS of POPULAR LINES



Wide mounting yoke permits correct alignment with wall surface.
Ample screw heads make wiring easy.
Finding slots facilitate cap insertion.
Contacts grip cap blades securely.
Strong Bakelite cup.
Available in brown and ivory.
Approved by Underwriters' Laboratories.

CONVENIENCE OUTLET No. 142

**BRYANT FLUSH
SWITCHES
and
CONVENIENCE
OUTLETS**

EASY WIRING AND INSTALLATION

THE BRYANT ELECTRIC COMPANY
SUPERIOR WIRING DEVICES
BRIDGEPORT 2, CONNECTICUT

NEW YORK

SAN FRANCISCO

CHICAGO

LOS ANGELES

A SUBSIDIARY OF WESTINGHOUSE ELECTRIC CORPORATION

Specify Bryant

Devices from

your Electrical

Wholesaler

feet, it apprecia
tubes. Based
two-lam
control
the air
single c
room.
the ligh
By utili
were m
and rep
mension
a minim
quired f
The
two-lam
volts, 6
450 vol
volts of
signed a
tric Co.
on the
diameter
top and
tion for
Imme
is the
the lam

**UNDER
TO AIR**

Airp
implies
area o
spaced
vals are
ing are
ground
series o
upon th
ing to
tion re
should
circuits
wire, 1
with ir
unit. B
15-watt
cuits)
With
drop sl
Since t
tional o
12,000
The
mounte
the ligh
the gro
the uni
center
of the
disconn
ground
from th

Electri

feet, it was found that there was no appreciable loss of current through the tubes.

Based on the results of this test, 18 two-lamp, 750-volt cold cathode ballasts controlling cove and ceiling lighting in the airlines office were mounted in a single cabinet located in the baggage room. Distances from this panel to the lighting tubes ranged up to 50 ft. By utilizing this arrangement, ballasts were made more accessible for repair and replacement and the physical dimensions of the cove could be kept to a minimum since no space was required for ballast housings.

The ballasts installed were of the two-lamp type, 105-watt capacity, 118-volts, 60 cycle, 0.9 amps; 120 ma. at 450 volts (operating voltage) and 700 volts open circuit. The cabinet, designed and installed by Hoffman Electric Co., Chicago, electrical contractors on the job, is equipped with five 2-in. diameter, screened vent holes in both top and bottom to provide air circulation for heat dissipation.

Immediately below the ballast cabinet is the lighting distribution center for the lamps involved.

UNDERGROUND CONNECTIONS TO AIRPORT BOUNDARY LIGHTS

WIRING

Airport boundary lights, as the name implies, outline the available landing area of the airport. The units are spaced at not more than 300-foot intervals around the perimeter of the landing area and are fed by an underground distribution system of either series or multiple circuits—depending upon the length of the circuit. According to Civil Aeronautics Administration recommendations, series circuits should be 6.6 amperes and multiple circuits may be 2-wire, 120 volts; 3-wire, 115/230 volts, or higher voltage with individual transformers at each unit. Boundary lights utilize either a 15-watt multiple lamp (multiple circuits) or a 320-lumen series lamp.

With multiple circuits, the voltage drop should be limited to 5 percent. Since this involves considerable additional copper cost, circuits longer than 12,000 feet are generally made series.

The boundary lights are normally mounted on sheet metal cones, so that the light is about 30 to 36 inches above the ground. For series circuits where the units come within 300 feet of the center line of a runway, the cones are of the tip-over type with a waterproof disconnect plug and receptacle at the ground and a flexible-cable connection from the plug to the lighting fixture.

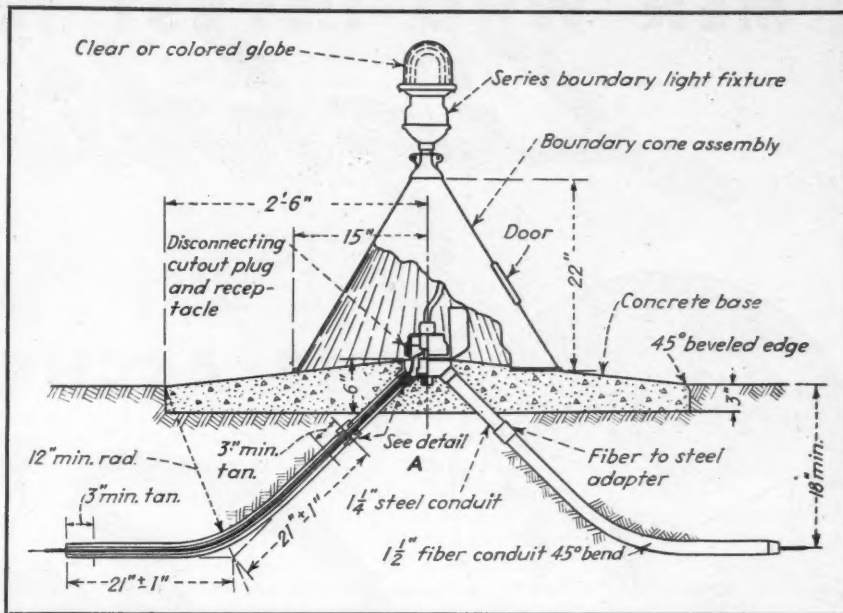


FIG. 1—Underground connections to airport tip-over boundary light units. Details show method of providing mechanical protection to cables entering the cut-out receptacle.

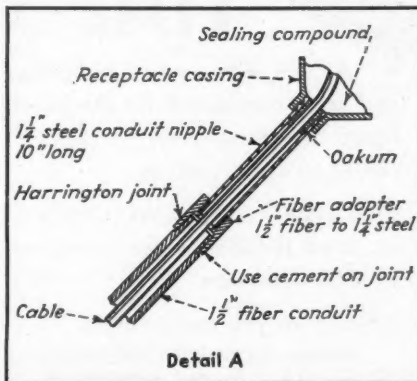


FIG. 2—Moisture seal at receptacle housing and fibre-to-steel connections underground shown in detail.

An access door is provided in the side of the cone to permit plug replacements. The entire cone rests on a circle of concrete, crushed stone or other granular material which is painted white. This adds to visibility from the air, prevents a growth of grass and weeds around the cone and simplifies the maintenance of the units.

Boundary lighting circuits are generally fed by such underground cable as parkway cable; lead-covered cable armored with a flat steel tape; or non-metallic armor or rubber-sheathed cables where soil conditions preclude the use of steel armor. At each boundary light location, the cable must turn up from its 18-inch deep trench, enter the plug, leave the plug and go underground again to the next unit. The cable is guided to these terminals and protected by fiber and steel conduit sleeves.

Connected to the bottom casting of the cutout plug and 90 degrees apart

(making a 45 degree angle with the ground) are two 1/4-inch steel conduit sleeves which are set in the concrete base of the cone unit. Connected to these through a fiber-to-steel adapter coupling are two 1/2-inch, 45 degree bend sections of fiber conduit which extend the mechanical protection of the cable to the trench level and several inches beyond the concrete base of the cone. Fig. 1 illustrates the recommended installation details.

As with any type of underground cable installation, provisions must be made to prevent entrance of moisture into the lighting unit from the underground conductors. Fig. 2, also taken from C.A.A. recommended practice, shows details of such a seal. Oakum and a sealing compound are used at the receptacle casting hubs.

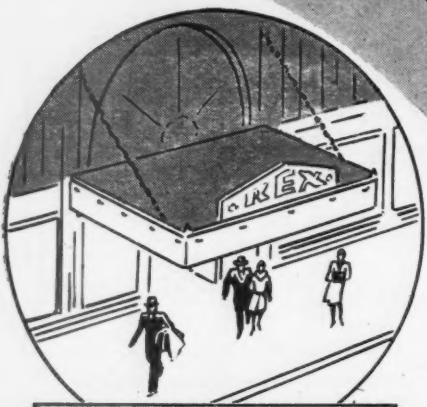


Leslie D. Price (left) manager, engineering and regulatory legislation section, NEMA, New York, gets some ideas from L. P. Dendel, Lansing, Mich., international president, I.A.E.I., at recent Chicago conference.

MEN WHO INVEST IN

Lighting

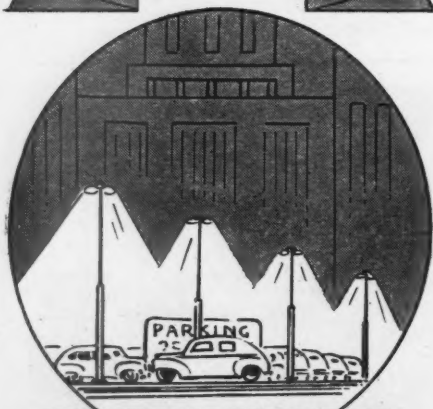
WILL BUY "ON AND OFF"
TIME ACCURACY . . .



For UTILITY



For ADVERTISING



For PROTECTION

Sangamo

TIME SWITCHES

As you know so well, a lighting installation has a very definite value and is so considered by the purchaser. Therefore, it is only logical to figure that these same purchasers of lighting will want accuracy for the "on" and "off" periods.

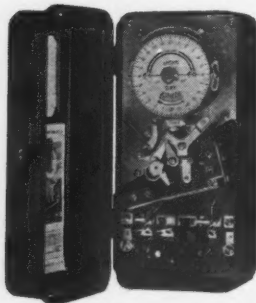
SANGAMO TIME SWITCHES are your answer in every case—it means an extra installation for you—and added profit, and exceptionally well pleased customers.

Let us give you more details.

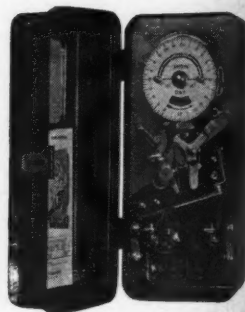
FORM KAZ—SYNCHRONOUS MOTORS SILVER CONTACTS

Six levers are provided for a maximum of 3 daily "on" and "off" operations. Accurate timing is obtained by turning the minute hand reset staff on the 24 hour dial. If desired the time-switch can be manually operated without affecting subsequent operations. Available in a wide variety of combinations providing two-circuits, duplex, and outdoor switches; also with Sunday and holiday omitting device, as well as advance time cutoff. The KAZ Astronomic Dial Time-Switch functions to close

the circuit at sunset and open it at sunrise, or the "off" operation may be set at any time between 9:30 P. M. and 2:15 A. M.



FORM VSW



FORM KAZ

FORM VSW—SYNCHRONOUS MOTOR—WITH CARRYOVER

Synchronous timing is combined with reserve spring clock operation, providing continuous operation during current interruptions up to ten hours. This entirely automatic carry-over eliminates the necessity of resetting the dial after current interruptions, and insures accurate timing under all conditions. Also equipped with Astronomic Dial.

ASTRONOMIC DIALS: Both of the Sangamo Time Switches shown here are equipped with Astronomic Dials. These dials enable "on" and "off" operations in accordance with sunset and sunrise.

SANGAMO ELECTRIC COMPANY SPRINGFIELD ILLINOIS

DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

XF-2

Installing Continuous Fluorescent Fixture Support

(How labor varies under working conditions)

BUILDING CONSTRUCTION:

Building has a high monitor center section; steel beams were formed by two "L's" with spacers in between; bottom of beams 25 feet above floor; section under construction was 100 feet wide by 140 feet long with beams parallel to width of unit on 20-ft. centers.

NATURE OF JOB:

Conveyorized production lines parallel the length of the building. Previous lighting method incorporated "goose-neck" incandescent reflector units on floor standards. Work involved installation of a continuous channel suspended from the ceiling to provide clear floor area. Channel was to support two-lamp industrial fluorescent units as well as air lines and air tools. Channel was not used as a raceway for wiring.

JOB CONDITIONS:

A heavy gauge steel, inverted-U channel, 3-in. high and 2-in. wide was fabricated with a 1/2-in. return lip on the bottom of each side. The welded two-piece construction was made in 10-ft. lengths which were bolted together as installed on the job. Small 2-in. by 1 3/4-in. flat steel plates with a 1/2-in. knockout and 3-inch long nipple were used to support the fixtures from the channel. After these drop-plates were inserted into the channel and rested on the lip projections, the fixture bodies were attached to the nipples and spaced about 5-ft., 6 in. on centers (ends of units about 18-in. apart). Fixture bodies were nipped together and three No. 12, Rockbestos circuit wires drawn through the line of bodies. Fixtures were spliced out, reflectors installed and units lamped. The channel was supported by a vertical 3/8-in. steel rod at 20-ft. intervals mounted to the steel beam. Rod was slipped between the "L's" of the beam and bolted to a steel plate with two additional holes to accommodate tie-rod supports mounted to mid-point of the channel suspension (10-ft. on each side of vertical rod). Complete rod suspension from each beam was triangular with vertical rod in center. Each rod was equipped with a turnbuckle just above the channel for quick adjustment and leveling of channel after fixtures were installed. There were six identical lines of fixtures, but installation problems varied due to congestion, interference by other trades, etc.

LABOR ANALYSIS:

This installation presents an unusual opportunity to check a repeated typical operation. Line No. 1 required initial planning and engineering and involved lost time inherent in initial operations. The conditions were not unusual despite a slightly congested floor and some interference by other trades setting conveyors.

Line No. 2 was clear with no interference from other trades. Here the labor dipped approximately 22 percent.

Lines No. 3 and No. 4 were installed under practically ideal conditions with labor dropping approximately 30 percent below that for Line No. 2.

Line No. 5 had a congested working condition and labor units returned to within 10 percent of those for Line No. 2, although the mechanics were now familiar with the installation.

Line No. 6 was installed under exceedingly unfavorable conditions—it was a rush job requiring addition of men unfamiliar with the work and other trades were congesting the area. The upward trend of labor units on Lines 5 and 6 was unexpected, but justified when conditions were studied.

LABOR CLASSIFICATION:

The men used on this job averaged "B" labor.

The types of labor available are rated A-B-C-D-E with the units based upon average use of "B" labor. In general, an "A" man will run the job assisted by "B" and "C" labor, which will average class "B". In abnormal times the general labor classification will fall to "D" and "E" for new labor being employed to fortify the regular personnel. It must be noted that the classification applies only to rate of time and not to knowledge or mechanical ability. A splendid mechanic may be rated "C" from a rate of time classification.

Labor Classification

A
B
C
D
E

Changes in Standard Units

deduct 10%
no change
add 10%
add 20%
add 30%

The labor classification shown in the estimating data above shows the labor classification rating of the mechanics who performed the particular job so that adjustment can be made on the type of labor available.

LABOR DATA

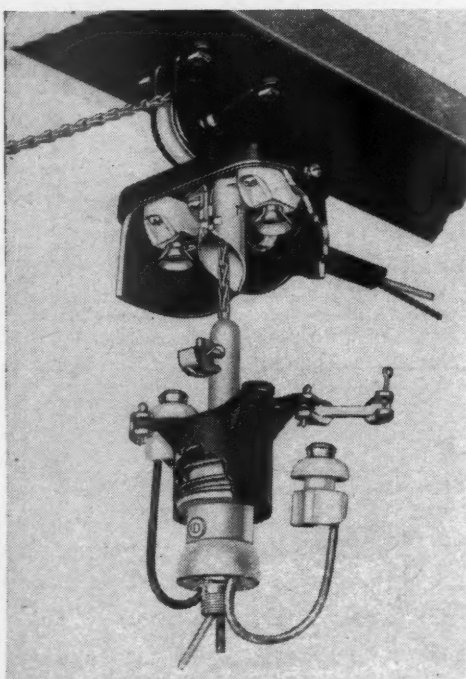
Operation	Man Hours											
	Line No. 1		Line No. 2		Line No. 3		Line No. 4		Line No. 5		Line No. 6	
	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total	Unit	Total
Measurements and layout.....		6.00		2.00		2.00		2.00		2.00		2.00
Fabricate, spot 22 15-ft. rods, 3/4" threaded one end, 3" at other.....	0.45	9.90	0.45	9.90	0.38	8.36	0.38	8.36	0.38	8.36	0.38	8.36
Fabricate, Spot 22 3-ft. rods, 3" thread one end, 1" at other end.....	0.15	3.30	0.15	3.30	0.12	2.64	0.12	2.64	0.12	2.64	0.12	2.64
Install 8 vertical rods and turnbuckles.....	0.40	3.20	0.35	2.80	0.18	1.44	0.18	1.44	0.40	3.20	0.40	3.20
Install 14 angle rods and turnbuckles.....	0.50	7.00	0.45	6.30	0.22	3.08	0.22	3.08	0.50	7.00	0.50	7.00
Install 140 ft. of channel, drill top for rods.....	0.26	36.40	0.18	25.20	0.11	15.40	0.12	16.80	0.20	28.00	0.24	33.60
Install 30 drop plates and nipples.....	0.15	7.50	0.10	5.00	0.07	3.50	0.07	3.50	0.07	3.50	0.10	5.00
Mount 25 fixture bodies, nipple together.....	0.40	10.00	0.35	8.75	0.25	6.25	0.25	6.25	0.25	6.25	0.35	8.75
Pull 450 ft. of circuit wire thru fixtures.....	10.00	4.50	10.00	4.50	9.00	4.05	9.00	4.05	9.00	4.05	10.00	4.50
Connect 25 fixtures, install reflectors and lamps.....	0.75	18.75	0.60	15.00	0.40	10.00	0.40	10.00	0.44	11.00	0.75	18.75
Level 140 ft. of channel—turnbuckles.....	0.057	7.98	0.057	7.98	0.043	6.02	0.043	6.02	0.043	6.02	0.044	6.16
Clean up.....		2.00		1.25		1.00		1.00		1.00		1.00
BREAKDOWN TOTALS.....		116.53		91.98		63.74		65.14		83.02		100.96
ACTUAL TOTAL TIME.....		116.50		92.00		63.50		65.00		83.00		101.00

Data from L. W. Witz, Continental Electrical Construction Co., Chicago, Illinois



*Engineered
Lighting
Provides for*

LOW COST, SAFE MAINTENANCE



● The Thompson Disconnecting and Lowering Hanger is essentially a latching type, overhead disconnecting switch and fixture lowering and raising device combined. It consists of two members. The upper member carries a pair of contact assemblies to which the current feed wires attach and is firmly secured to the supporting structure. The lower member carries the engaging contact assemblies wired to the lighting fixture which it supports. This permits fixture to be lowered to floor level for regular cleaning and relamping and provides a quick—easy—safe—low cost method of servicing.

Thompson Hangers are designed

for practically all types of Industrial, Commercial, indoor and outdoor lighting—for airplane hangers, aeronautical obstruction lights on stacks and other obstructions. In fact they are recommended for almost any installation where fixtures are mounted more than fourteen feet above floor or ground level or in locations not readily accessible . . . Thompson Hangers assure adequate lighting facilities without over-lighting and accessibility without interrupting production or interfering with normal operation of business. They offer a solution to your problems of high cost lighting maintenance and assure quality illumination.

Our Engineers offer full cooperation with Architects, Consulting Engineers, Contractors, Plant Engineers and Superintendents of maintenance in planning—laying out—and specification of the Thompson Hanger best suited to the individual installation. Feel free to call on them for help.

THOMPSON

DISCONNECTING & LOWERING
HANGERS

THE THOMPSON ELECTRIC CO.

1101 POWER AVENUE

• CLEVELAND 14, OHIO

Electrical Contracting, December 1945



The Victory Lighting Jubilee

THE first exhibition of lighting equipment covering all the major lighting markets—commercial, office, industrial, school and residential—took place in New York City during the week of November 26.

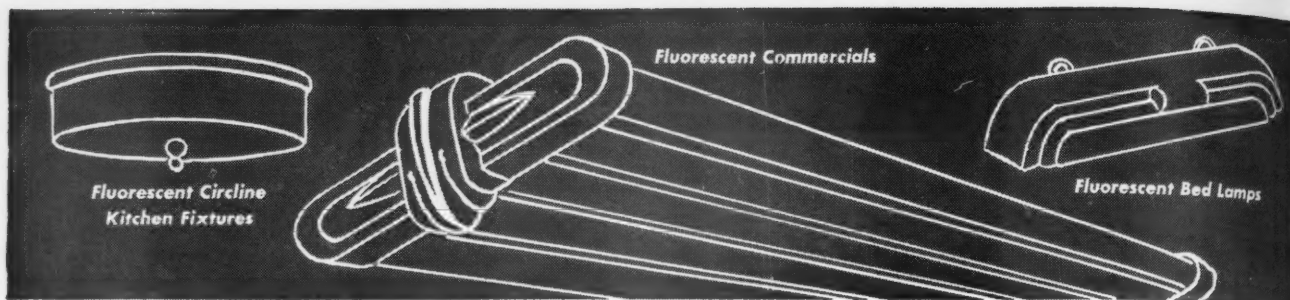
THE Lamp Department of General Electric is proud to have sponsored this Victory Lighting Jubilee. But by far the largest share of credit for the exhibition's significance and success must go to the many manufacturers of lighting fixtures and portable lamps who participated.

THE entire lighting industry is indebted to them for making it possible to see under one roof the results of their work to date. Their exhibits demonstrated very clearly the great progress lighting has made and indicated the direction of further development. Everyone who visited the Jubilee was impressed with the wealth of designing talent and manufacturing skill displayed . . . and came away firmly convinced of the lighting industry's great future.

THE Lamp Department of General Electric deems it a privilege to have been associated in this enterprise. The progress already achieved is noteworthy. General Electric will continue to do its share toward even greater accomplishment through the development of new and better G-E Lamps.

M. L. Sloan

Vice President
General Electric Company



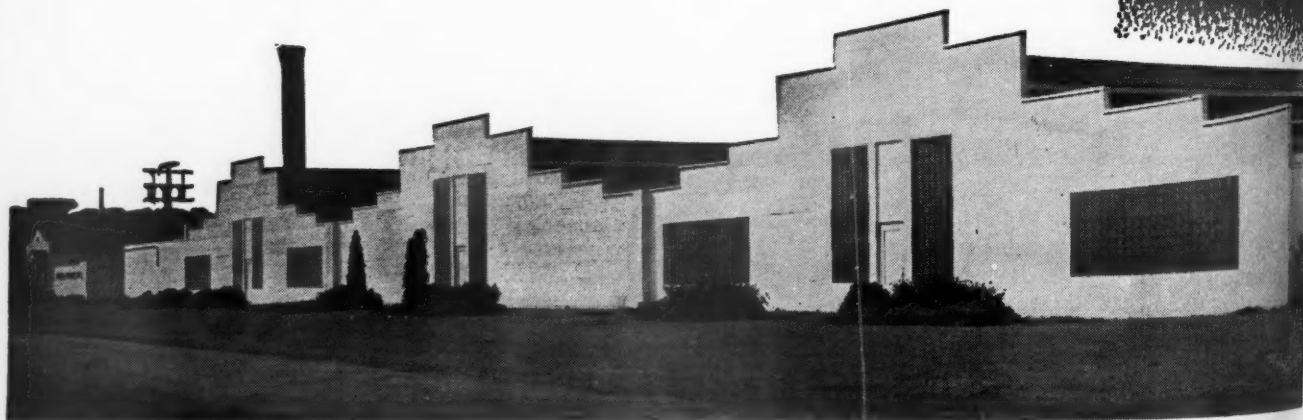
for Fluorescents of the future!

● The complete line of Lighting Products Fluorescent Units, designed to more than complement your customer's most fastidious surroundings and constructed to give long carefree service, will give you the many sought after selling features you have been looking for.

Our New Daylight Plant is now in full production and is equipped to perform all steps in the conversion of raw materials to complete fixtures. With all operations under one roof, centralized control of quality and uniformity are your guarantee of the finest in fluorescent fixtures and satisfied customers.

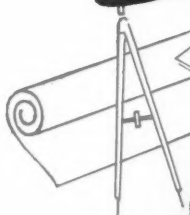
**Manufacturers of Fluorescent Commercials, Industrials, Bed Lamps
— Circline Kitchen Fixtures, Table Lamps and Floor Lamps — Desk
Lamps, Show Case Fixtures, Strip Lighting and Germicidal Units.**

LIGHTING PRODUCTS, INC.
HIGHLAND PARK • ILLINOIS



Designed

FOR THE TIMES



The Presidential Series



of Pittsburgh Permaflector



Fluorescent Luminaires



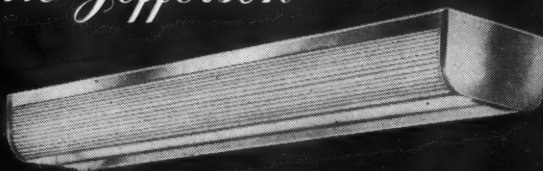
All Presidential Luminaires are available in two, three and four lamp units utilizing 40-Watt T-12 fluorescent lamps. For surface mounting or suspension mounting—individually or in continuous row.



The "Presidential Series," as shown at the New York Victory Lighting Jubilee, is typical of the outstanding lighting equipment designed by Pittsburgh Reflector Company. For over 30 years the *Permaflector* trademark has been the symbol for quality lighting—designed for efficiency and easy

installation and maintenance. Before you specify . . . before you buy—investigate *Pittsburgh Permaflector* Fluorescent and Incandescent Lighting Equipment. Full details will be provided by your nearest *Pittsburgh Permaflector* representative or wholesaler.

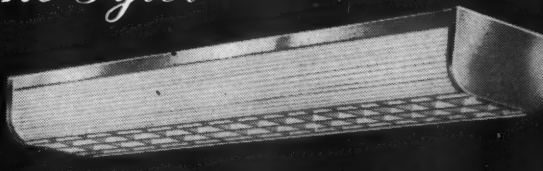
The Jefferson



The Van Buren



The Tyler



The Wilson



Pittsburgh Reflector Company

OLIVER BUILDING
PITTSBURGH 22, PA.



DISTRIBUTED BY BETTER
ELECTRICAL WHOLESALERS
EVERYWHERE

BEST MERCHANDISING

ELECTRO Fluorescent Basic Unit!



**INSTANTLY CONVERTS TO TYPE OF
LUMINAIRE YOU NEED!...WITH
PACKAGED ACCESSORY SETS**

***NOW...You can make
immediate delivery
on large orders...with-
out maintaining huge
expensive stocks!***

Obviously, you've got a better chance of landing large orders if you can *complete* delivery immediately. THIS NO LONGER NECES-SITATES EXPENSIVE BIG INVENTO-RIES ON EACH TYPE OF COMMERCIAL LUMINAIRE. You need stock only one major item—the ELECTRO BASIC UNIT, which you can convert instantly into any type commercial luminaire, with the aid of acces-sories from packaged sets. Thus, with a much *smaller* total stock, you can fill *larger* orders for any given model.

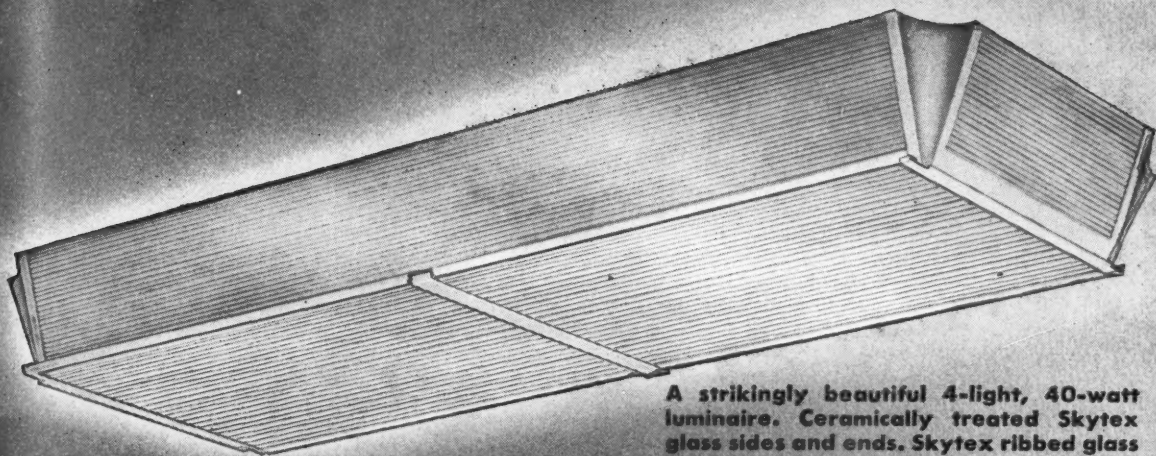
Moreover, when you sell Electro luminaires you are sure of a satisfied customer. For no other line of fluorescent lighting offers all the features and all the quality you get in Electro ... engineered for highest levels of lighting, yet with amazingly low surface brightness ... Starters and lamps instantly removable from the top, and wiring more readily accessible than on any comparable fixture ... Patented suspension bracket that enables *one man* to install any fixture in less time than is ordinarily required by two men ... Designs of breathtaking beauty ... A selection of models affording exact desired concentration of light.

Send for literature showing the spectacular engineering improvements featured in these fluorescents. Sold only by verified electrical wholesale distributors.



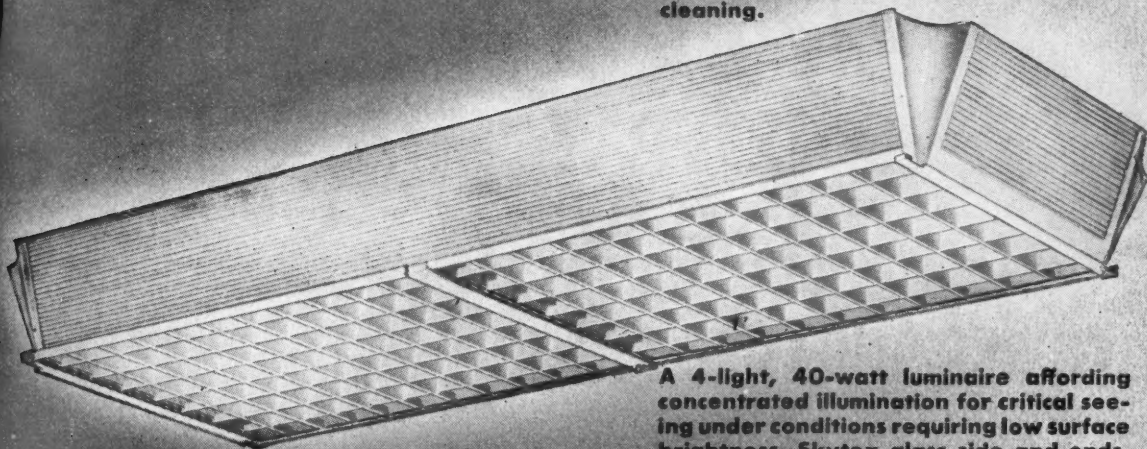
ELECTRO MANUFACTURING CO • CHICAGO

AID EVER OFFERED!..



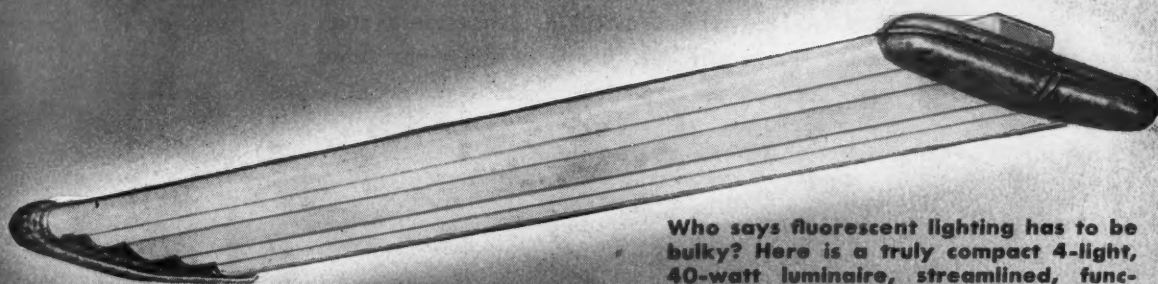
***ELECTRO U. R. C. LUMINAIRE, NO. 1041**

A strikingly beautiful 4-light, 40-watt luminaire. Ceramically treated Skytex glass sides and ends. Skytex ribbed glass bottom panels. Transmits scientifically diffused maximum light, clear and glareless as the daylight in a room with ideal north exposure. Glass easily removed for cleaning.



***ELECTRO LOUVRE MODEL, NO. 1043**

A 4-light, 40-watt luminaire affording concentrated illumination for critical seeing under conditions requiring low surface brightness. Skytex glass side and ends. Steel concentrator panel in bottom contains louvres of size and number determined by extensive laboratory experiment to assure highest efficiency. An unusually handsome luminaire.



***ELECTRO'S NO. 1044**

Who says fluorescent lighting has to be bulky? Here is a truly compact 4-light, 40-watt luminaire, streamlined, functional. Utilizes highest percentage of lumen output of the bare lamps. No dark spots on ceiling. Exquisitely designed bakelite ends in rich walnut grain.

ALSO AVAILABLE: No. 1022, two-lite, 40-watt luminaire, same style as 1044.

***FOR FLUSH OR PENDANT MOUNTING,
IN CONTINUOUS LINE OR INDIVIDUALLY**

NEW!



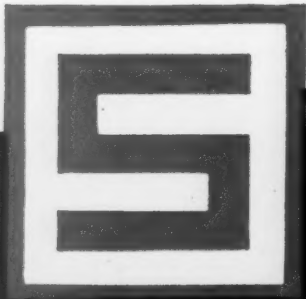
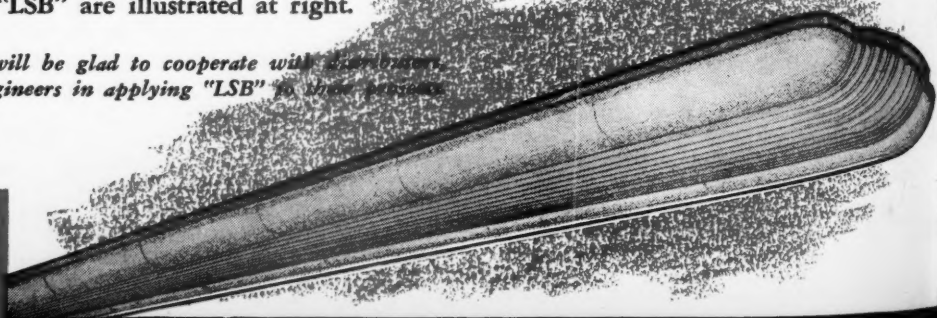
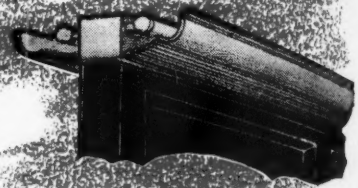
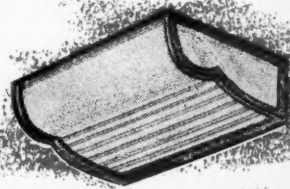
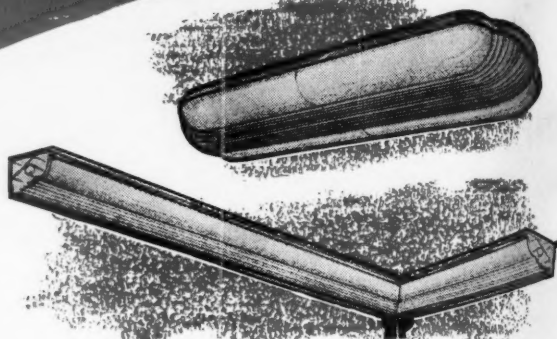
**SPERO
"LSB"**

(Low Surface Brightness)

GLASS SHIELDED FLUORESCENT

Modern illuminating engineering has been applied to architectural glassware, bringing fluorescent lighting into harmony with the most smartly appointed interior decorations. Light is shielded by ceramic-finish glass, achieving high transmission with low surface brightness. Scientific design controls light in desired areas. Glass is molded in 12" sections—individual sections easily removable. Adaptable to stem or flush mounting, singly or continuous. A few of the many other applications of Spero "LSB" are illustrated at right.

Spero engineers will be glad to cooperate with distributors, contractors or engineers in applying "LSB" to their designs.



THE SPERO ELECTRIC

18222 LANKEN AVENUE

THE
FLUO

The Spero
engineers
requirement
orders w

1 SPERO
for fo
easy

2 SPERO
40 W
remov

3 SPERO
sizes—
100 V

4 SPERO
bathro
for tw

5 SPERO
Made
four 2

6 SPERO
48", 6

7 SPERO
All ch

8 SPERO
lightin
ename

9 SPERO
in 18"

Write

Electrica

THE CORRECT FIXTURE FOR EVERY FLUORESCENT INSTALLATION

The Spero line of fluorescent luminaires represents correctly engineered, attractively designed units for practically every requirement. Items illustrated are now in production and orders will receive prompt attention.

- 1 SPERO "LVR"—Masterpiece of Fluorescent Engineering. Made for four 40 W tubes. Light is shielded by louvres, hinged for easy maintenance.
- 2 SPERO "CVG"—Low-cost glass shielded luminaire. Made for four 40 W tubes. Ceramic finish (Claralite) glass panels are easily removed for cleaning. May be used without glass.
- 3 SPERO "IU"—Low maintenance industrial unit. Available in 3 sizes—for two 40 W tubes for three 40 W tubes and for two 100 W tubes.
- 4 SPERO "KU"—Designed for residential installation in kitchen, bathroom, etc. White or colors to match decorative schemes. Sizes for two or three 24" tubes.
- 5 SPERO "WL"—Window Lights for store windows, displays, etc. Made in three sizes, for two 48" tubes, four 48" tubes and four 24" tubes.
- 6 SPERO Channel Strip—Single light units are available for 24", 48", 60" and 96" tubes.
- 7 SPERO Channel Strip—Two-light units are available in 48" size. All channel strip finished in white baked enamel.
- 8 SPERO "B" series Wall Brackets for decoration or supplementary lighting available in 18" or 24" tube sizes, chromium or white enamel finish.
- 9 SPERO "BD" series Wall Brackets—with attached shield—available in 18" or 24" tube sizes, chromium or white enamel finish.

Write for descriptive bulletins on any or all of these Spero fixtures.

SPERO INSTALITE

providing instantaneous lighting without starting switches, is available on most Spero luminaires for slight additional cost.

ELECTRIC CORPORATION

★ CLEVELAND 19, OHIO

We have changed our name

to **Kahn** Manufacturing Co., Inc.

WE felt this was a very necessary step because too many people confused our name for the general name of the product we make. True we make Fluorescent Fixtures . . . but their distinctive features deserve an identifying name that cannot be mistaken.

. . . and so we did the obvious thing . . . selected the name of the founder and present active head of the organization . . . **Charles Kahn**. We will continue to use the trade mark "Firefly" both on our current fixtures and on the new models being introduced.

Each unit is now packed in a **NEW ENGINEERED CARTON SPECIFICALLY DESIGNED** for our own fixtures. **WE'RE NOW PROUD OF OUR PACKING.**

Write for our brand-new bulletins and price lists which are now available.

Delivery

IS BEING MADE ON MOST MODELS IN THREE TO FIVE WEEKS. ON SOME MODELS WE CAN DO EVEN BETTER.

Kahn Manufacturing Co., Inc.
2051 N. 19th Street
MILWAUKEE 5, WIS.

Formerly

Fluorescent Fixtures, Inc.

Manufacturers of the Famous "Firefly" Fixtures



Curtis **EYE COMFORT** *Luminaire*

**No. 1020
FOR
500 or 300-WATT
SILVER BOWL LAMPS**

Here is a unit that rates "tops" whenever silver bowl lamps are specified... the Curtis No. 1020 is a graceful, shallow-bowl design, delivering high efficiency.

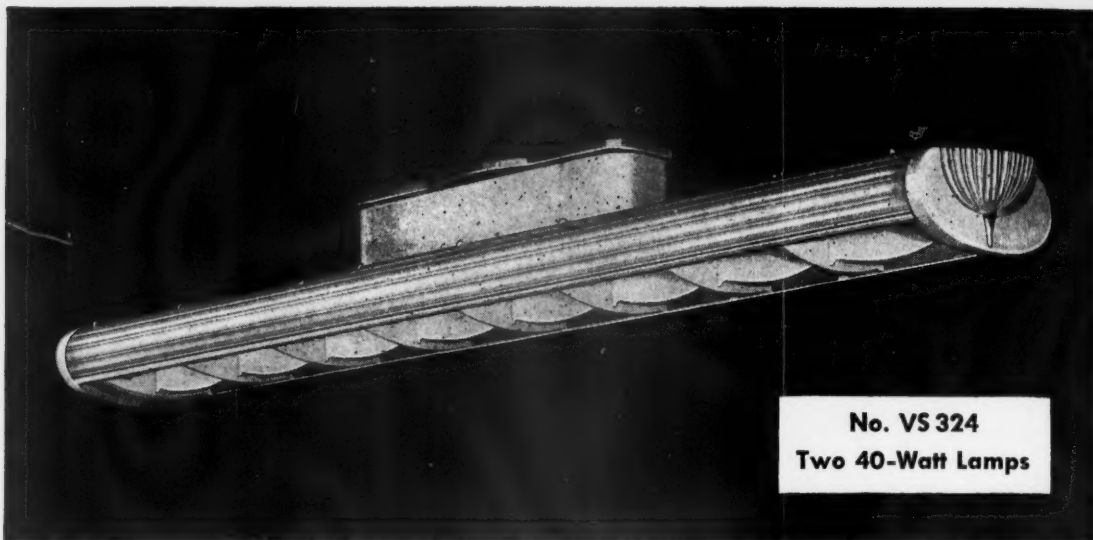
A single lamp-neck shield is regularly included, and for low ceiling installations a second shield is supplied at no extra charge if so specified.

Maintenance is easy and fast because the lamp is removable through the bottom of the bowl.

The unit is made of Alzak Aluminum in a beautiful grained finish with a polished ring at the base of the bowl. Write for specification sheet No. 2168.

CURTIS *Lighting, INC.*

6135 WEST 65TH STREET, CHICAGO 38, ILLINOIS



No. VS 324
Two 40-Watt Lamps

VIRDEN

Fluorescent

by

John C. Virden Co.
CLEVELAND, OHIO

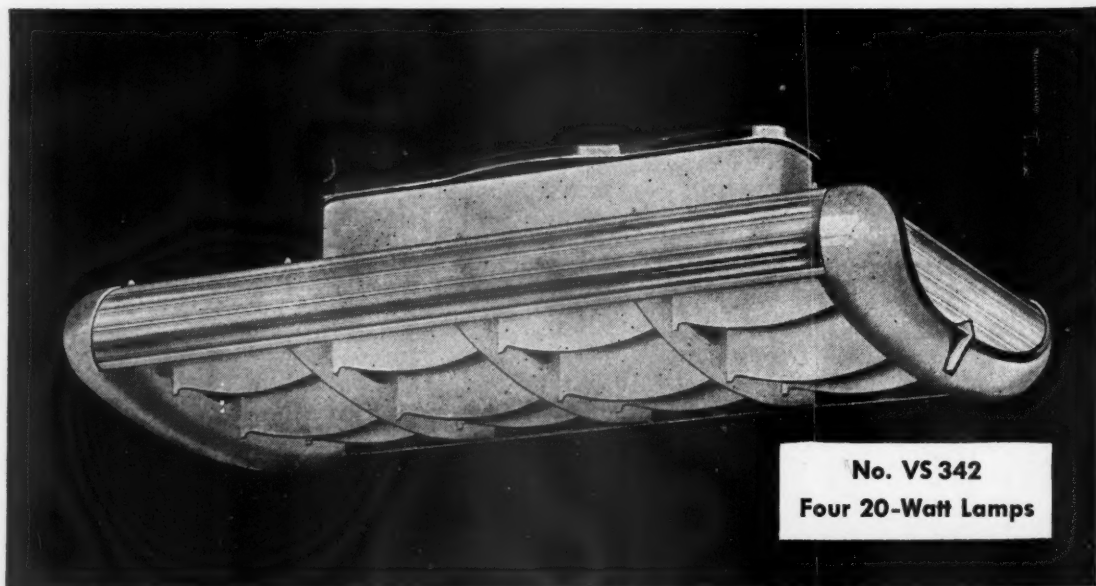
*At the Victory Lighting Jubilee
Nov. 26th to 30th • Booth 69 • Aisle E*

Here they are!

Yes, here are the brand new fixtures we invited you to come and see!

Clean-cut, smart conceptions with a happy use of plastic, offering a practical solution for effective and discriminating use of Fluorescent in the home.

To see them is to agree that they bring you the sparkle of originality, the charm of glamour and, of course, wide sales opportunity. More new fixtures of typical Virden character are on the way.



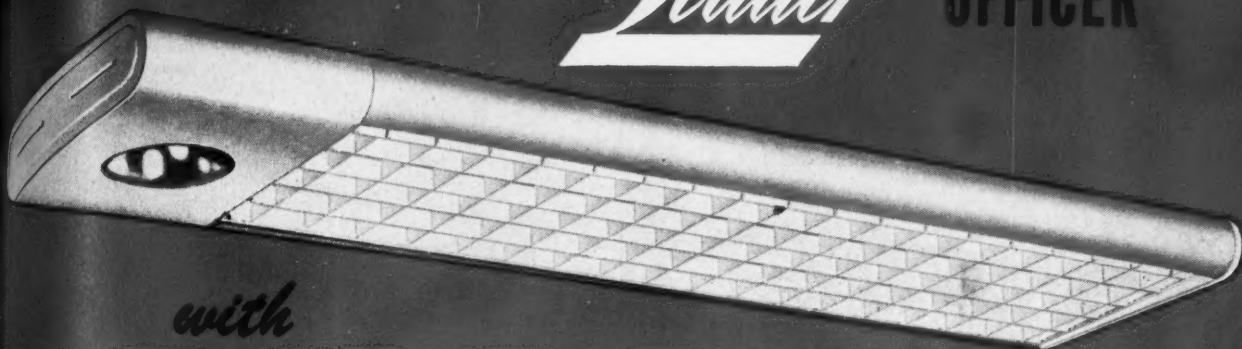
No. VS 342
Four 20-Watt Lamps

NOW

THE

Leader

OFFICER



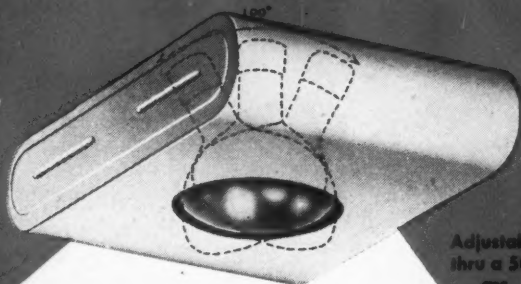
with

"DIRECLITE"

The most Outstanding Commercial Fixture
Plus MERCHANDISE

"Spot"

LIGHTING



Adjustable
thru a 50°
arc

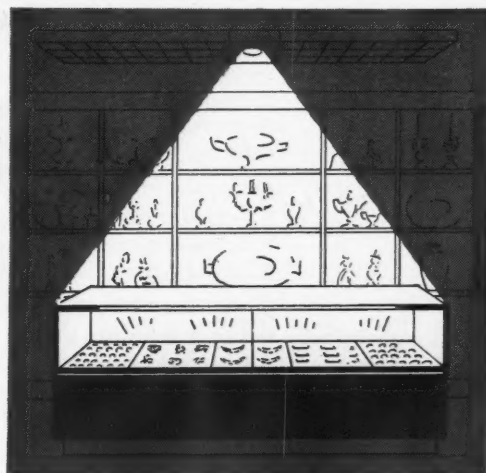
Leader Engineers now present the Direclite for spot lighting of merchandise. Direclite is easily attached at the end of a single unit or the center of a continuous run installation where any Leader Officer is used.

Thousands of installations have already proved the superiority of the Leader Officer Unit. Here is a fixture combining utility and high light output with beauty of design.

Now the Officer Unit is available for additional merchandising uses, thus giving it extra merit to the high position it already enjoys.

Representatives in all principal cities.

Distributed only through the Better Electrical Wholesalers



THERE IS A LEADER REPRESENTATIVE
IN YOUR AREA

Leader

ELECTRIC MANUFACTURING CORP.

6127 NORTH BROADWAY • CHICAGO 40, ILLINOIS

WEST COAST FACTORY • 2040 LIVINGSTON STREET, OAKLAND 6, CALIF.

General Electric Lamp Research Expands your Lighting Markets

FOR the first time since the start of the war, the lighting industry has an unlimited opportunity to fulfill the promise of modern lighting in all fields of application. And General Electric Lamp Research, released from wartime tasks, has completed development of new light sources that will expand still further the demand for higher levels of lighting.

General Electric SLIMLINE Fluorescent Lamps will accentuate the trend to long, slender flowing lines of smooth light and encourage higher standards of lighting in stores, schools, offices and factories. General Electric CIRCLINE Fluorescent Lamps will stimulate the use of fluorescent in the home—and in many store applications. The whole G-E line of sealed-reflector bulbs, such as the R-40 reflector lamp and infrared heat and drying lamps, will come into wider use.

Other developments are on the way. General Electric has already announced a new low-brightness fluorescent lamp—and a phosphor that will make possible a long, tubular highly-efficient sunlamp that works just like a fluorescent lamp.

The demand for lighting is tremendous. General Electric Lamp advertising is building the market by channelling this demand into a desire for higher standards of lighting. And General Electric Lamp Research is constantly at work to provide new and better lamps to help promote the progress of the lighting industry.



1. G-E Slimline Fluorescent Lamps

The advantages offered by G-E SLIMLINE Lamps—length and slimness, plus operating advantages such as instant-starting and low-brightness—are certain to encourage higher standards of store and office lighting. Dimensions of the longer lamps (72" and 96" long, one inch in diameter) recommend them for use end-to-end in ceiling fixtures, as shown at the left. The shorter lamps (42" and 64" long, three-quarters of an inch in diameter) will find many applications in showcases, shelf-edges, show-windows and similar uses. And G-E CIRCLINE Fluorescent Lamps make possible a wide variety of new display units to highlight merchandise.

2. G-E Circline Fluorescent Lamps

Introduction of G-E CIRCLINE Lamps opens up the portable lamp field to fluorescent lighting. The circular shape affords many new design opportunities and fixture manufacturers are designing floor and table lamps for a wide range of interiors. The model at the left, combining a 12" G-E CIRCLINE with a G-E 3-Lite bulb, gives twice as much useful reading light as the best prewar "Better Sight" portable lamp. Applications of G-E CIRCLINE Lamps are not limited to portable lamps—they make possible new designs in overhead fixtures for both the commercial and residential markets. First G-E CIRCLINE Lamp, now in production, measures 12" in outside diameter. Two additional CIRCLINE Lamps (8½" and 16") will be made available next year.



G-E LAMPS

GENERAL  **ELECTRIC**



STAY BRIGHTER LONGER !

Research is Always at Work to
Improve G-E Lamps and Make Them

Electrical Contracting, December 1945

Lighting's strongest



*Naturally, Certified Ballasts and Starters are a key part of Fleur-O-Lier Certification

Why Fleur-O-Lier Means Assured Unexcelled Quality

More than thirty leading manufacturers, producing a large variety of types and styles, have won the right to build Fluorescent Fixtures with the Fleur-O-Lier label.

To qualify, a product must first be built to rigid and authoritative specifications covering lighting performance and electrical and me-

chanical standards.

But before a fixture is *Certified* and entitled to wear the label, it must pass rigid tests by Electrical Testing Laboratories, Inc.

Even then, samples from regular production are subject to re-check. *Continued* quality is assured.

sales story in . . .

2 1/2 **SQUARE**
INCHES 

This Famous Fleur-O-Lier Label Helps Sell More Than 30 Leading Makes of Fluorescent Fixtures

Fluorescent Fixtures with the Fleur-O-Lier Label do a great job for your customers. But don't forget, they do just as much for you. When you feature luminaires with this label, sales come faster. You don't need to spend time reassuring the buyer regarding quality and value. *And*, you'll be giving the kind of satisfaction that builds steadily increasing long-continued business. Make Fleur-O-Lier labeled fixtures standard policy. Both you and your customers will do better.

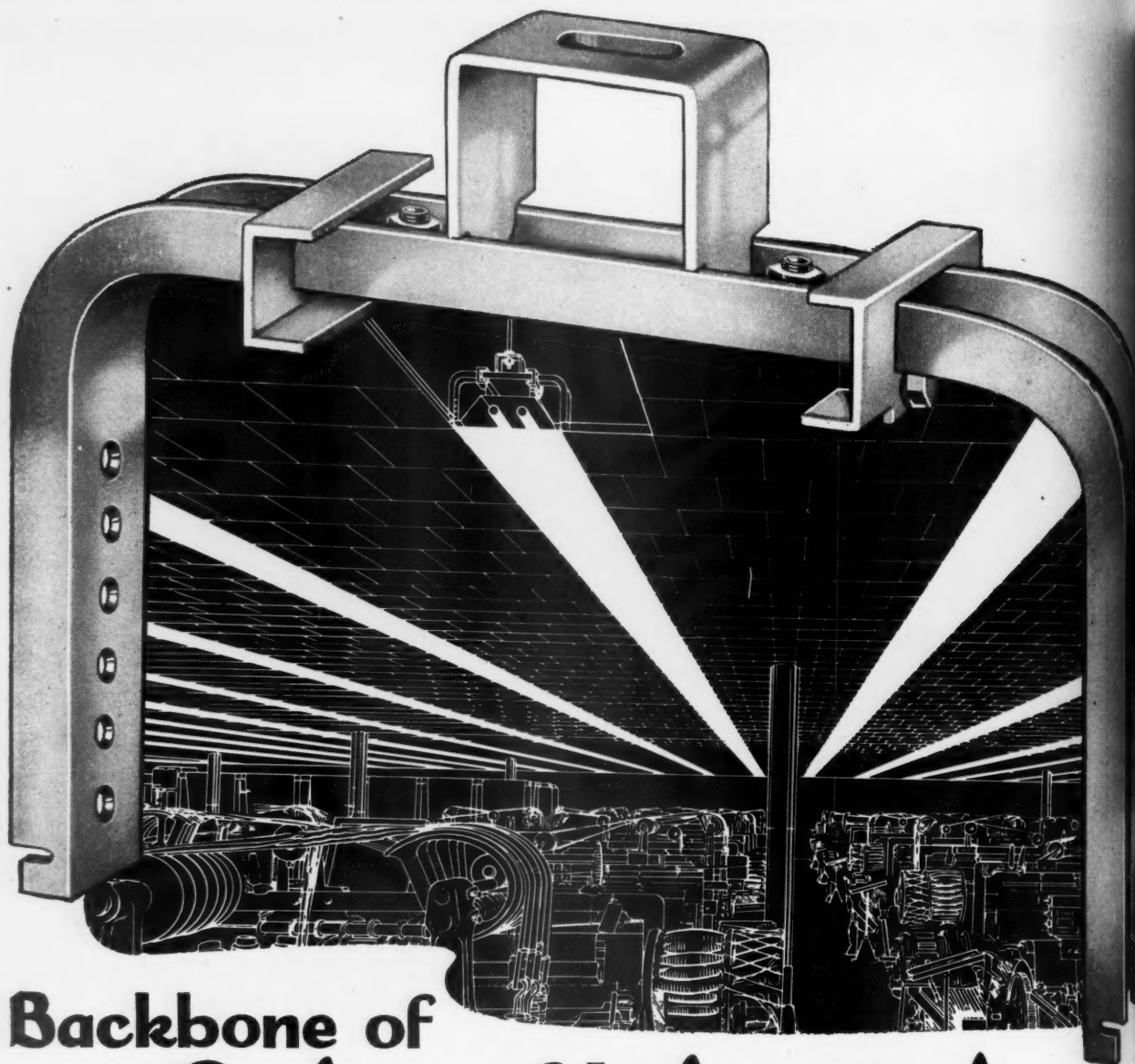
Fleur-O-Lier Manufacturers, 2116 Keith Bldg., Cleveland 15 Ohio

FLEUR·O·LIER

Manufacturers

CERTIFIED FIXTURES FOR FLUORESCENT LIGHTING

Participation in the FLEUR-O-LIER MANUFACTURERS' program is open to any manufacturer who complies with FLEUR-O-LIER requirements.



Backbone of Ceilings Unlimited

... the patented Miller Ceiling Furring Hanger for any type furred ceiling

This unique bracket is the "can do" behind today's trend in construction and renovation... the trend of planning interiors *around the lighting*.

Designed, patented and produced only by The Miller Company, this ingenious hanger licks many old construction problems—without creating *new* problems.

It is no longer necessary to laboriously fit recessed lighting into hung ceilings. Instead, one simply hangs Miller Ceiling Furring Hangers from the structural ceiling—and furring, tile and Troffer

Lighting System are hung *from the hangers!*

Thus, installation is speeded, wire, wiring and conduit costs are cut—substantially—simple leveling means are provided... and, because less than half the usual supports are needed, there is more "above ceiling space" for piping and air conditioning ducts.

The complete story is too big for this page. It is fully told in the new brochure catalog—**CEILINGS UNLIMITED**.

Miller Engineers and distributors are located in principal cities.

THE MILLER COMPANY • MERIDEN, CONNECTICUT

ILLUMINATING DIVISION
Fluorescent, Incandescent
Mercury Lighting Equipment

HEATING PRODUCTS DIVISION
Domestic Oil Burners
and Liquid Fuel Devices

ROLLING MILL DIVISION
Phosphor Bronze and Brass
in Sheets, Strips and Rolls

WAR CONTRACTS DIVISION
War Materiel

FOUNDRY DIVISION
Non-Ferrous Metal Castings



Dependable Guides



RLM STANDARDS INSTITUTE SPECIFICATIONS

- RLM Specification No. 1—
Dome Reflector
- RLM Specification No. 2—
Deep Bowl Reflector
- RLM Specification No. 3—
Symmetrical Angle Reflector
- RLM Specification No. 5—
48" Fluorescent Two-Lamp Closed-End
Porcelain Enamel Unit
- RLM Specification No. 6—
18" Fluorescent Three-Lamp Closed-End
Porcelain Enamel Unit
- RLM Specification No. 7—
60" Fluorescent Two-Lamp Closed-End
Porcelain Enamel Unit
- RLM Specification No. 8—
60" Fluorescent Two-Lamp Closed-End
Porcelain Enamel Diffuser Unit
- RLM Specification No. 9—
48" Fluorescent Two-Lamp Open-End
Porcelain Enamel Unit
- RLM Specification No. 10—
48" Fluorescent Three-Lamp Open-End
Porcelain Enamel Unit
- RLM Specification No. 11—
60" Fluorescent Two-Lamp Open-End
Porcelain Enamel Unit
- RLM Specification No. 12—
60" Fluorescent Two-Lamp Open-End
Porcelain Enamel Diffuser Unit
- ★RLM Specification No. 18—
Glassteel Diffuser.
★New RLM Approved Unit

to the best in INDUSTRIAL LIGHTING EQUIPMENT

Lighting reflectors that look very much alike may differ greatly as to quality and efficiency. Accurate measurement of these differences at the time of purchase is difficult... requires exacting laboratory and engineering tests not readily available to those who purchase and specify lighting equipment.

Hence the value of RLM Standard Specifications in establishing basic standards of efficiency, design and quality... and the RLM Label to identify lighting equipment built to meet these standards. This label certifies that the industrial lighting equipment on which it is affixed has been manufactured and inspected in compliance with the exacting procedure developed and administered by RLM Standards Institute.

Every RLM specification is drafted by a Technical Committee guided by the findings of the Illuminating Engineering Society, the recommendations of the *Better Light-Better Sight Bureau* and other recognized industry associations. These specifications are available without charge through manufacturers utilizing RLM inspection and certification service, or direct from RLM Standards Institute.



307 N. Michigan Ave., Suite 420

Chicago 1, Illinois

WATCO CREATES

Exhibit of Fluorescent Fixtures Draws Many at VICTORY LIGHTING JUBILEE

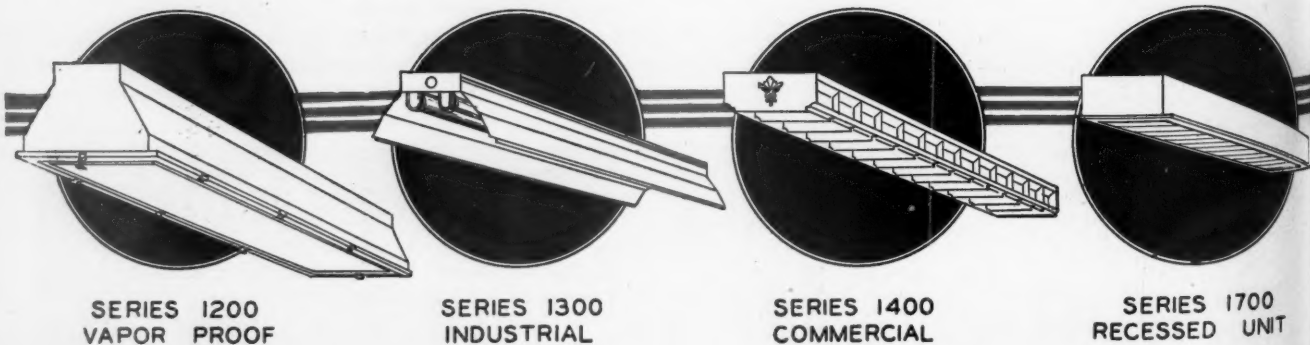


NEW YORK (DEC. 1st) The Watco line really attracted New York City's Jubilee crowd . . . Electrical Contractors, Wholesalers, Utility Lighting Engineers, Architects and Builders, Store Executives and Building Managers. Visitors at the exhibit had demonstrated to them by Watco Engineers many outstanding developments in the Watco line, such as time-saving installation features, flexibility in mountings and continuous-run assemblies.

Watco's diversified line of Fluorescent Fixtures includes Commercial and Industrial Fluorescent Fixtures, Desk Lamps, Kitchen Units, "Draft-O-Lamps," Recessed and Troffer Units.

Modified Series 1400 Unit, using the new 96" 52 watt Slimline Lamp. Available in 2, 3 or 4 lamp units. It is to be noted that an incandescent section of the gimbal ring with an R 40 type lamp is used for highlighting displays and for floodlighting merchandise. This is an individual unit and can be inserted in any length run quickly and easily. It also provides a streamline effect for modern lighting.

Send for Catalog
WATCO ENGINEERS



SERIES 1200
VAPOR PROOF

SERIES 1300
INDUSTRIAL

SERIES 1400
COMMERCIAL

SERIES 1700
RECESSED UNIT

WIDE INTEREST

Arch
Build

Our Engineering Staff is maintained solely to render service to you. You are invited to send your details or specifications and we shall be glad to submit blueprints showing the most efficient and economical solution to your lighting problems. Inquiries on items of your own design are always welcomed and will be given our prompt attention. The particular inventive genius, ingenuity, skill and ability that makes one product better than another also makes one kind of fluorescent fixture superior to another.

A partial view of first floor installation, Kaufman's Department Store, Pittsburgh, Pa. Sold by General Electric Supply Co., Pittsburgh, Pa.



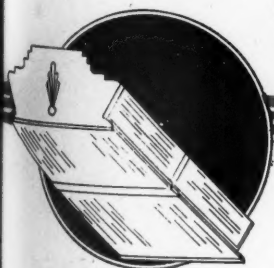
for Complete Catalogs and Details
ENGINEERING, INC.

Specialists in Custom Made Lighting

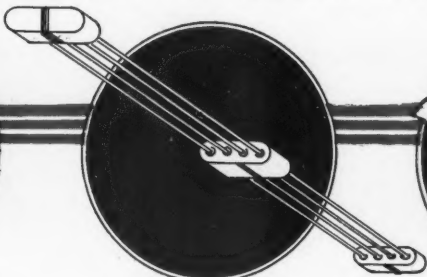
FLUORESCENT DIVISION

CLEVELAND, OHIO, U. S. A.

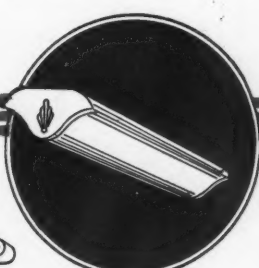
"WINCO" VENTILATING WINDOW DIV. • "TEMPZONE" AIR CONDITIONING DIV.



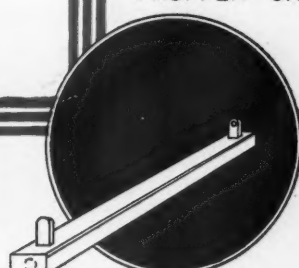
SERIES 2100
COMMERCIAL



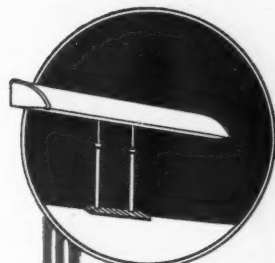
SERIES 2600
SLIM LINE



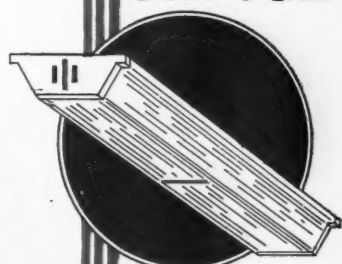
SERIES 2500
KITCHEN UNIT



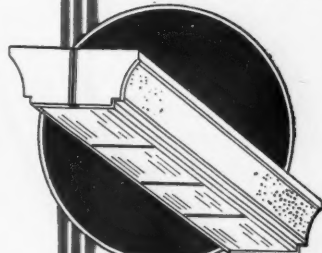
SERIES 1800
STRIP UNIT



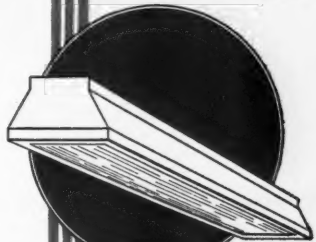
SERIES 1500
DRAFT-O-LAMP



SERIES 2300
COMMERCIAL



SERIES 1900
COMMERCIAL



SERIES 1600
TROFFER UNIT

Confidence



As business turns from war to peace, the promotion and maintenance of confidence between seller and buyer are of paramount importance. Confidence in representation made concerning quality and performance of goods fortunately exists wherever business is conducted along sound lines. Such confidence may be confirmed and intensified through the independent sustained determinations of quality that feature ETL services. If the client chooses to make public the results of such determinations, the process may become certification.

Brochure and Pamphlet on
Certification supplied
upon request



ELECTRICAL TESTING LABORATORIES, INC.
2 EAST END AVENUE AT 79TH STREET • NEW YORK 21, N. Y.

*After a whole year of testing various makes and types
of Office Lighting Fixtures*

ARMOUR and COMPANY

CHICAGO PACKERS

CHOOSE

Famous MITCHELL U.R.C.* Luminaire



6 TIMES MORE LIGHT THROUGHOUT ENTIRE OFFICE BUILDING

For a full year, Armour's engineers tested many types of lighting fixtures . . . many different makes. MITCHELL U.R.C. Luminaire won . . . *just as it has won in lighting tests all over America.* 1500 units of Mitchell U.R.C. Model No. 2032 were installed . . . surface mounted individually and in continuous rows. All general and private offices throughout entire 6-floor building now enjoy abundant, glareless light. 37 footcandles is average maintained . . . 6 times more light than before! Write for Catalog No. 267 giving full facts and lighting data on Mitchell U.R.C. Model No. 2032.

** This is the original U.R.C. designed by the Utilities Research Commission, and introduced by Mitchell.*

Distributor on Job: Graybar Electric Co., Inc., Chicago Office
Contractor: Fries Walters Co., Chicago

MITCHELL
FOR TOP LIGHTING VALUE

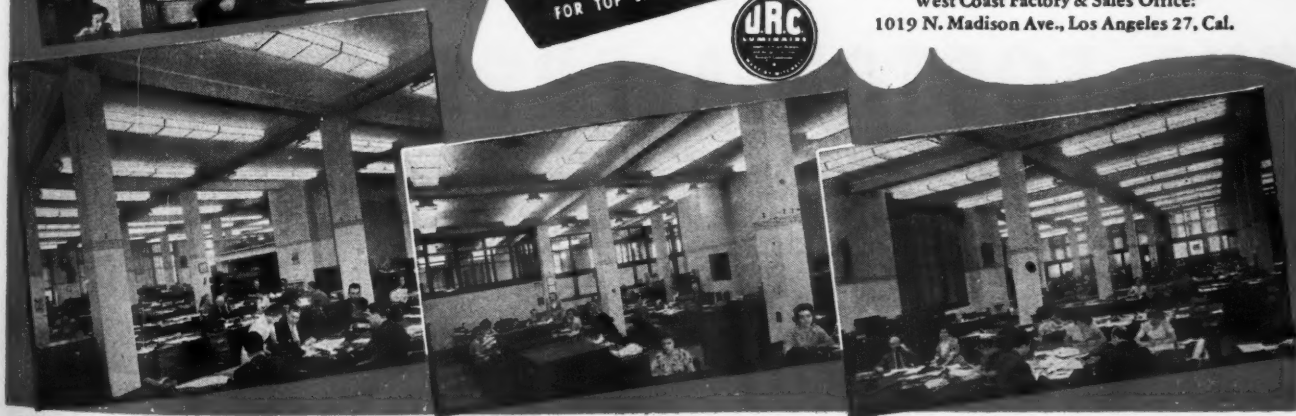


Mitchell Manufacturing Company

2525 CLYBOURN AVENUE, CHICAGO 14, ILLINOIS

West Coast Factory & Sales Office:

1019 N. Madison Ave., Los Angeles 27, Cal.



*To Step-up
YOUR PLANT
EFFICIENCY*

**BETTER 'SEEING'
... IMPROVE AND**



LOCALITE Model 3267-H-174-SV

Directs up to 200 footcandles intense illumination on critical work. Used for small machines, lathes, grinders, drill presses, etc.



LOCALITE Model 3470-P-172-SV

Directs up to, 300 footcandles intense illumination on critical work. Used for bench and table operations, assembly, sorting, inspection.



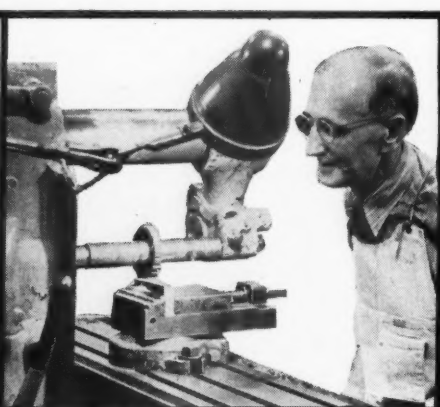
LOCALITE Model 3267-FLB-170

Directs in excess of 100 footcandles fluorescent lighting on critical work. Ideal for certain bench assembly and inspection work.



LOCALITE Model 3267-C-172-SV

Directs up to 150 footcandles intense illumination on critical work. Used for large machine tools and similar equipment.



LOCALITE Model 3267-U-172

Concentrates up to 250 footcandles intense illumination on critical work. For small part assembly, inspection and precision machining.



GENERALITE Model 300

For larger area localized lighting. A highly efficient fluorescent unit with excellently designed shielding, operating and maintenance features.

THE FOSTORIA PRESSED STEEL

Specialists in Industrial Lighting for

**THE FOSTORIA FORMULA
FOR PRODUCTIVE LIGHTING
ON THE JOB**



Careful Study of
Critical Work Areas



Determination of
Lighting Required



Recommendation of
Lighting Installation



G' TOOLS FOR YOUR WORKERS D SPEED PRECISION PRODUCTION

Eye-efficiency controls production efficiency. Make it easy for your workers to see quickly and accurately the vital tasks they are doing. Give them "seeing" tools fitted to their seeing need.

Machining, assembly, and inspection operations require illumination of 100 footcandles and more—directed on the critical work-area—to provide efficient seeing conditions. Anything less retards the eye speed and accuracy of the worker—reduces his output—increases your costs.

Localites, in various models, solve the problem of providing each different type of precision job with the proper quantity and direction of light for the seeing task. The worker directs illumination exactly where he needs it. A Localite is his "seeing" tool, matched to his particular task.

Localites in the right combination with general lighting is known as Balanced Lighting. The greater efficiency and economy of this modern method of productive industrial lighting is cutting costs for thousands of plants. It will help you improve the competitive position of your plant. Write, now, for a Fostoria representative to analyze your lighting needs.



REQUEST THIS FREE BOOKLET, TODAY

For complete facts on how Fostoria Balanced Lighting will improve and increase your production, write for this complete catalog and detail information on the advantages of Fostoria Lighting Service.

LIGHT FOR SEEING ON THE JOB

Increases Production

Enables workers to see faster and comfortably—speeding their tasks.

Prevents Errors

Quick, accurate seeing avoids costly mistakes.

Reduces Accidents

Good seeing guards against accidents.

Improves Worker Morale

Comfortable seeing conditions make better workers.

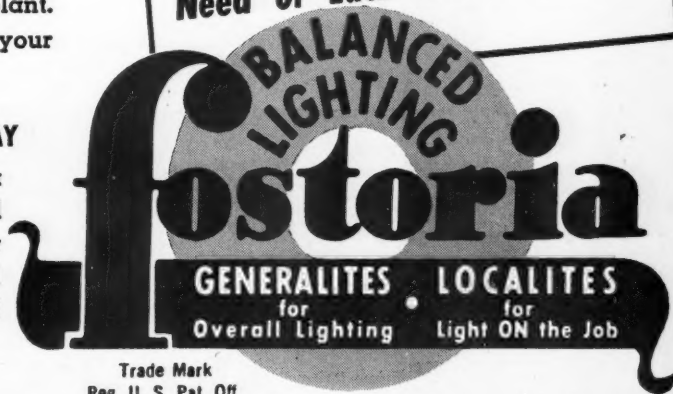
Lowers Costs

Faster and better production cuts costs.

Saves Expense

Balanced lighting usually takes less equipment—and less maintenance.

**Critical Work Area Lighting
ENGINEERED to the Seeing
Need of Each Worker's Task**



L CORPORATION • FOSTORIA, OHIO

Better Seeing



After-Application Service

SEEING THAT
= MATCHES THE
WORKER'S NEED

Fostoria Products manufactured in Canada by Amalgamated Electric Corp., Ltd., Toronto, and distributed through all Northern Electric branches.

EXPORT SALES DEPT.: 401 Broadway, New York City.

Fostoria Lighting Equipment and service available through selected wholesalers and distributors from Coast to Coast.

Guth ALZAK Aluminum Lighting

T. M. REG. ALCOA



ALZAK (2-40w) FLUOFLECTORS arranged in continuous rows on 9'6" spacings, with 10'0" mounting, produce 32 to 35 Foot-Candles. Guth (2-20w) LOCAL FLUOFLECTORS over certain benches provide 110-125 Foot-Candles. Engineered by Mr. L. D. Lyon, Consumers Power Co., and sold by Electric Wholesale Supply Co., both of Jackson, Michigan.



ALZAK HIGHBAYS in large Pennsylvania warehouse. Spacings are 20'0" by 20'0", with 27'3" mounting-height. Alternate units utilize 400w Mercury-Vapor, and 750w Incandescent to produce 20 Foot-Candles of uniform illumination. Engineered by owner's Electrical Department; sold by Kingsport Electric Co., Kingsport, Tenn.

SUPER-PUNCH "Light-Kick" REFLECTORS

FOR FLUORESCENT AND INCANDESCENT LAMPS

For Light-Control, Efficiency, Punch and Permanence, Guth ALZAK Aluminum reflectors are top-quality. They are processed ALZAK in the Guth Co's. own plant, under quality-controlled supervision.

Engineered reflector contour is omnipotent (where ALZAK reflectors are concerned). Then the Guth ALZAK process electrolytically brightens the formed Aluminum metal for high efficiency; finally, it permanently seals in this efficiency with an aluminum-oxide coating that is second in hardness only to the diamond!

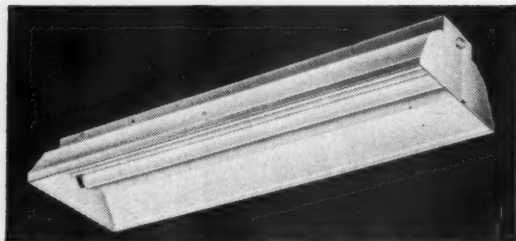
Yes, a Guth ALZAK Reflector is a good, efficient, tough Reflector!



GUTH SURGERY-LITE

T. M. REG.

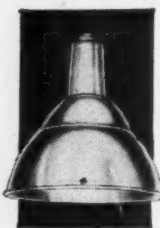
Spectacular photo above, shows intense light-beam (directed via Guth ALZAK control) piercing a dark haze. Only a small 100-watt Incandescent lamp bulb (1340 Lumens) is used, yet more than 2000 Foot-Candles are developed on the operating table (48" beneath the fixture), with over 1000 Foot-Candles (average) over a 6" circle.



ALZAK FLUOFLECTOR

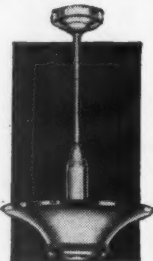
T. M. REG.

ALZAK reflectors "control" and "direct" the Fluorescent light rays to the useful working-plane. FLUOFLECTORS are available in Open-End and Closed-End types. For individual or continuous-row layouts. Sizes are: 2-40, 3-40 and 2-100 watt. Eggcrate Louvers available for added lamp-shielding, where desired.



GUTH HIGH-BAYS

ALZAK light-control is the most efficient, least expensive method for effective lighting of high-bay areas (25'0" or higher). Guth lists 3 types (30°, 60°, and 90° beams), and each type in 2 sizes (300-500w and 400w (Mercury) or 750-1500w).



YORK INDIRECTS

Super efficient, nicest looking incandescent-indirect we ever produced. "Light-spill" softly illuminates YORK'S exterior, which blends the luminaire in with the lighted ceiling. Made in 3 sizes, for 200 to 1500 watt lamps.



YORK ALZAK INDIRECTS using 750w. T-24, Bi-pin lamps on 9'0" by 10'0" spacings, 11'7" ceiling-height, 8'7" mounting-height, provide 50 Foot-Candles of uniform lighting. Complete absence of glare despite horizontal positioning of drafting table top. Sold by Whipperman-Mitchell Co., Buffalo, N. Y. See I.E.S. Data Sheet 13-19 for further details.



ALZAK (2-40w) FLUOFLECTORS with Eggcrate Louvers, are arranged in "45° Angle-Spacing" on 6'0" centers, with 9'6" mounting. There are 74 Foot-Candles on the drafting tables (not 1 Foot-Candle variation); the "45° Angle-Spacing" provides "close to shadowless lighting", a remarkable achievement with Direct-Shielded form of lighting. Sold by Eoff Electric Co., Portland, Oregon.

Leaders
in Lighting
Since 1902



THE EDWIN F. GUTH COMPANY • 2615 Washington Ave. • St. Louis 3, Missouri

Time Now...to Have Your ELECTRICAL CONTRACTOR Make Your STATION LIGHTING CHECKUP



**"Look to BENJAMIN
for helpful co-operation"**

This and other ads promoting the services of the electrical contractor will appear at this time in Super Service Station and other publications reaching the automobile dealers, garages and gasoline service stations. Boosting the contractor has been for years and will continue to be an integral part of the Benjamin sales program.

Make Sure Your Lighting Measures Up to the Stiffer Requirements of POST-WAR SELLING!

THIS IS A MESSAGE for you station operators who know that the day will soon be here when pre-war standards and methods won't be good enough for any department of service station operation!

One of the CHANGES that's certain to come is this: Improved service station lighting inside and out. For companies' plans and station surveys show that a boom in station modernization is on the way! MUST MEAN Better Lighting, too, because it's proven over and over again that no station is sized without Good Lighting.

**Your local Electrical Contractor is ready
to help you in TWO WAYS:**

**First: HELP YOU TO GET THE MAXIMUM BENEFIT OUT
OF YOUR PRESENT LIGHTING SYSTEM**

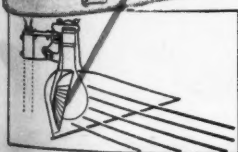
**Second: HELP YOU PLAN AND GET BENJAMIN LIGHT-
ING THAT WILL KEEP YOUR STATION OUT IN FRONT
OF COMPETITION !!!**

THEY'RE BACK! The Original 2-in-1 and Most Popular of
all Service Station Floodlighting Units...

BENJAMIN DUO-SERVICE FLOODLIGHTS



Again the leader of Benjamin's complete line of service station floodlighting equipment will be DUO-SERVICE... the unit that revolutionized station floodlighting! Featuring Benjamin Life-Time Porcelain Enamel and Built-Like-a-Battleship Benjamin construction, these Floodlights give you MORE FOR YOUR FLOODLIGHTING DOLLAR. That is why there are over 20,000 stations using them... they make every lamp do double duty... they deliver maximum light at minimum cost... are easy to clean... and last a lifetime! Ask your Electrical Contractor about them...



SPOTLIGHTS
THE BUILDINGS



FLOODLIGHTS
THE GROUNDS

In your community there is one or more electrical contractors who, by experience and training, is well qualified to survey your station lighting requirements. Ask one of them to study your modernization plans, and submit a lighting recommendation. You can depend upon him to provide you with Lighting Equipment that is designed and built to give you maximum lighting efficiency at a minimum of operating and maintenance cost!

Calling in your electrical contractor is insurance against disappointment and assurance of satisfaction.

Benjamin Electric Mfg. Co., Dept. H.

Des Plaines, Illinois

BENJAMIN

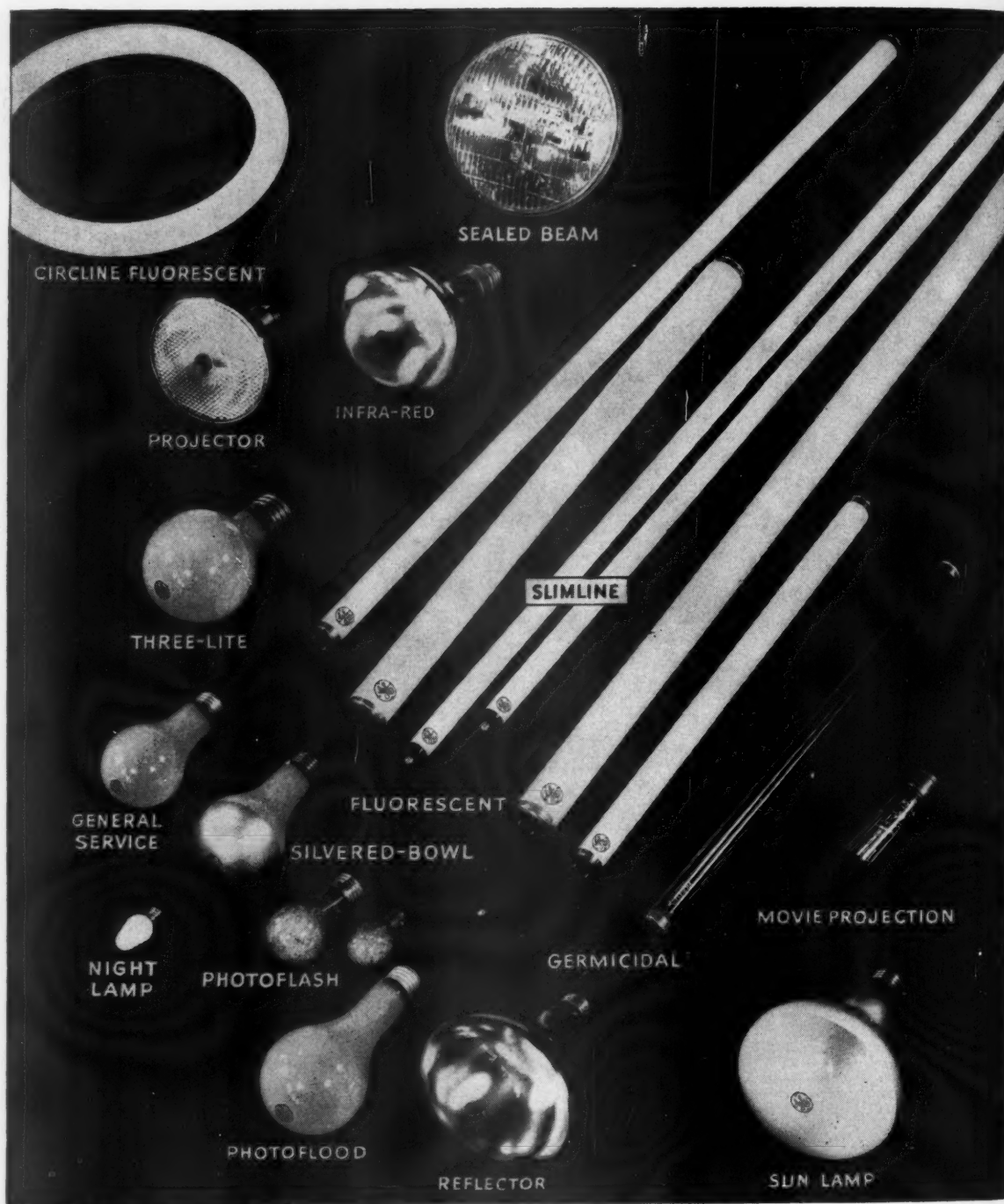
TRADE MARK

SERVICE STATION LIGHTING and Floodlighting EQUIPMENT

Distributed exclusively through electrical wholesalers

G-E MAKES A COMPLETE LINE OF LAMPS—Whatever your lighting need, General Electric makes the lamp to fill it. General Electric's complete line of lamps is as near as your

telephone—one call takes care of all your requirements. Strategically located warehouses assure you prompt and reliable service. Look to G-E for all your lamp requirements!



G-E LAMPS

GENERAL  **ELECTRIC**



Research is Always at Work to
Improve G-E Lamps and Make Them

STAY BRIGHTER LONGER!

What?
'46 Co
that the
to adop
go into
the 1946
to you
also tha
voted ag
fuses, an
manufact
as "not
At the
tee meet
ber, it v
Article
solely as
ter on t
trical Co
clude th
Report:
"Unim
metal ra
cuits wh
crease th
structura
made at
adopt th
cussion,
propos
tive and
In Pa
to rule
non-met
quire bal
metallic
down, an
be used.
In Pa
was vot
rated sw
conduct
cuit. C
switch
been use
Article
cealed K
a parag
in Wall
the com
purpose
Article
been en
Code ca
for color
of the c
of wire
the prop
coding a
requirem
felt othe
mains as
The co
feeder, a
Electric

What's In The '46 Code

(FROM PAGE 55)

that the Electrical Committee voted to adopt this requirement, which will go into effect with the effective date of the 1946 Code. To complete my report to you on this subject, I should state also that the Power & Light Group voted against the adoption of Type "S" fuses, and the National Electrical Manufacturers group asked to be recorded as "not voting".

At the time of the Article Committee meetings in New York last November, it was agreed by members of the Article 300 Committee, purely and solely as a means of getting the matter on the agenda of the entire Electrical Committee for discussion, to include the following in the Committee Report:

"Uninsulated neutrals may be used in metal raceways on existing feeder circuits where it is impracticable to increase the size of the raceway due to structural conditions". A motion was made at our recent code session to adopt this wording. After some discussion, a vote was taken, and the proposal was defeated, with 19 affirmative and 26 negative votes.

In Paragraph 3703 it was proposed to rule out metallic outlet boxes on non-metallic wiring systems and require bakelite, porcelain, or other non-metallic outlet boxes. This was voted down, and therefore metallic boxes may be used.

In Paragraph 6241 (Elevators) it was voted to require a horsepower rated switch as a disconnect for the conductors to the elevator motor circuit. Otherwise a general purpose switch rated in amperes could have been used.

Article 324, which deals with Concealed Knob & Tube wiring, contained a paragraph about Thermal Insulation in Walls. This has been deleted, as the committee felt it served no good purpose and could not be policed.

Article 210—Branch Circuits—has been entirely rewritten. The 1940 Code carries a mandatory requirement for color coding of circuits. Because of the difficulty in getting any kind of wire during the past several years, the proposal was to make such color coding a recommendation and not a requirement. However, the majority felt otherwise, and color coding remains as a mandatory rule.

The code permits a common neutral feeder, and it was proposed to permit

a common neutral for two or more multi-wire branch circuits. I believe this practice was formerly sanctioned. A motion was carried, to leave this out of the new code, and thus not to permit common neutrals for multi-wire branch circuits.

On the other hand, another fineprint note appearing as a recommendation only, was changed to code text as a mandatory requirement. This will then state, that where in normal operation the maximum load of branch circuits will continue for long periods of time, the unit load calculations should be increased by 25 percent. This to provide for sufficient branch circuit and feeder capacity to insure safe operation.

The carrying capacity of conductors on range circuits was discussed, and it was voted to require a minimum of 2—No. 8 and 1—No. 10 wire. Remember that these will now be rated at 40 and 30 amperes, respectively.

In Paragraph 2125-b it will be stated that in computing the maximum load on circuits having lighting units employing ballasts and the like, the total load must be taken and not merely the wattage of lamps or tubes.

The completely rewritten Article 410 on Lighting Fixtures contains new rules pertaining to cold cathode fixtures. The special provisions for electric discharge lighting systems of 1000 volts and over, in Paragraph 4171 say the following about Lamp Terminals & Lampholders:

"Lamps or lampholders or both shall be so designed that there shall be no exposed live parts when lamps are being inserted in place, or are being removed. Parts which must be removed for lamp replacement shall be hinged or fastened by approved means."

This proposed rule was bitterly protested by a representative of the Illuminating Engineering Society, feeling that it would put many manufacturers of cold cathode units at a serious disadvantage, and that to comply would necessitate a redesign of their present units. However, a special committee appointed to discuss the matter and try to affect a compromise, reported back a unanimous vote to stick to the proposed requirement 100 percent, with the proviso that it go into effect one year after the Code becomes effective. This gives the makers of cold cathode units about two years to redesign their fixtures to comply with the Code.

During the war the use of black enameled electrical metallic tubing (thinwall conduit) was permitted.

With the publication of the new code, black enameled tubing will not be acceptable, and I presume its manufacture should stop long before November 1946.

In Article 338, pertaining to Service Entrance Cables, the use of such cables in interior wiring to ranges had been approved even though the cable had an uninsulated grounded conductor. A proposal to extend this permission to domestic hot water heaters was defeated, whereupon a motion was passed requiring insulated conductors on water heater circuits.

During the war the use of busways increased tremendously, and lessons learned on wartime installations lead the way to modification and improvement in code rule wording. We now will state definitely that busways shall not be used outdoors, or in wet or damp locations unless especially approved for the purpose. Also that if a busway is installed in a vertical position, the supports for the busbars shall be designed for vertical installation. Note that this wording refers to the support of the busbars rather than to the busway itself. The use of hook sticks to operate switches in busways at an elevation above the floor has often been questioned, because these switches do not comply with the requirement of being "readily accessible". The committee felt that it would not be practical to bring busways down to a point reachable from the floor, and so the rule has been modified to fit the condition, by saying that switches and circuit breakers, *so far as practicable*, shall be readily accessible and grouped. Another item pertaining to busways has to do with reduction in size of busway without overcurrent protection. The situation here is of course entirely different from insulated cable where we limit the load to protect the insulation. However, it was felt that some reasonable limitation should be imposed on busway taps without overcurrent protection, and a limit of fifty feet was set.

In Article 380—Switches—for the first time we now have a definite requirement that switches and circuit breakers shall be of the externally operable type, enclosed in metal boxes or cabinets. Another somewhat related rule also appears for the first time, in Section 2440, to say that disconnecting means shall be provided on the supply side of all fuses and thermal cutouts in circuits of more than 150 volts to ground, and cartridge fuses in circuits of any voltage, if accessible to



**"PLUG-IN"
POWER**

TO BRING MACHINE ARRANGEMENTS

Up to par



... ONE OF 22 WAYS YOUR

**WESTINGHOUSE
DISTRIBUTOR**

CAN HELP YOU MODERNIZE
Electrically

Unhandy and inaccessible power circuits make changes in machine arrangements difficult and expensive. They place an added handicap in the way of changing plant layouts to meet the standards of efficiency established by new and modern war plants.

A Westinghouse Bus Duct system makes "plug-in" power available *where you need it*—makes machine arrangement completely flexible to meet changing production requirements. Outlets every 12 inches permit taking off power through circuit breaker or fused plug-in units.

Westinghouse Bus Duct is just one more example of the completeness of the help your Westinghouse Distributor can give you in bringing your plant up to par electrically. Call on him for help in making a complete electrical checkup—he can tell you what's new about a lot of other things electrical and can give you the benefit of his experience with the electrical problems of many other plants.

T-60597

21 OTHER WAYS your Westinghouse Distributor can help you in planning electrical modernization, whether for a single department or your entire plant, are suggested in this new book. It provides a valuable check list on modern electrical practice ... from incoming electrical power to methods of utilization and control. Ask your Westinghouse Distributor today for a copy of B-3476, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.



Westinghouse
PLANTS IN 35 CITIES . . . OFFICES EVERYWHERE



other than qualified operators, so that each individual circuit containing fuses or thermal cutouts can be independently disconnected from the source of electrical energy. This means that you finally will get in the National Code what we have had in the Wisconsin Code for twenty years. Namely, a switch ahead of a cartridge fuse, to make it safe to change fuses. I regard the adoption of this new rule as much overdue but nevertheless still a progress-making improvement.

Another item pertaining to the new fixture rules should be mentioned. This rule will read about as follows: "In general, fluorescent fixtures when supported independently of an outlet box, shall be connected through metal raceway or armored conductors. This requirement may be waived where cord-equipped fixtures are suspended directly below an outlet and the exposed cord is not subject to strain or mechanical injury". I recommended saying that a fixture shall be connected to and supported from an existing outlet provided for the purpose, but while that wasn't accepted, the above wording will go a long way toward doing away with connecting fixtures to the nearest outlet by long cords.

One of the most important Code sections is Article 500, dealing with Hazardous Locations. It would be almost impossible to deal with that highly technical subject here in the time allotted. Suffice it to say, that Article 500 has been completely rewritten, and that it is based now upon the degree of hazard involved in parts of a plant, or in different floors of a plant, or in different parts of the same floor, rather than to regard the entire area as having the same degree of hazard. The Article 500 Committee undertook and has completed a tremendous task.

In regard to Article 430—Motors and Controllers—I want to report on one paragraph in particular which should be of interest to contractors whether estimating a new job from a blueprint or wiring an installation in an existing building with motors of known characteristics actually on hand. Many times you are asked to figure a plan which indicates the location of motors of certain horsepower here and there about the building. No one however, knows at that stage of the game what the exact characteristics are of the motors to be selected and furnished later on by someone else and shipped to the job. To provide for proper size of motor branch circuit and feeder conductors, new Section 4309 says: "Whenever the current rating of a

motor is used to determine the current carrying capacity of conductors, switches, branch circuit over-current devices, etc., the values given in Tables 21-24 of Chapter 10 shall be used in lieu of actual current rating marked on the motor name plate. Motor running over-current protection shall be based on the motor name plate." This rule should make uniform the estimating of motor circuit conductors, switches, and fuses, instead of cutting too close for certain special types of motors. Columns 7, 8, 9, and 10 of Table 20—the motor table—indicate the maximum allowable rating of branch circuit fuses. Section 4347 of the 1946 Code will say that: "If fuses are used for motor-branch-circuit overcurrent protection, the fuseholders shall not be of a smaller size than required to accommodate the fuses specified by Table 20."—Compliance with this rule will in some cases necessitate a redesign of the switch assembly, as certain sizes of horsepower-rated switches do not have cutout blocks large enough to accommodate the maximum size of fuse listed in Table 20. For example a $7\frac{1}{2}$ hp. 3 phase, 220 volt motor should have a 70 ampere cutout according to Table 20, yet various manufacturers' catalogues show a 60 ampere switch as a $7\frac{1}{2}$ horsepower-rated switch.

The importance of the National Electrical Code to electrical contractors cannot be overestimated: it guides our entire business activity. Therefore, we must be ever on the alert to study new trends and cooperate with other interested industry-groups.



Chicago electrical contractors T. L. Hankins (left), Condo Electric Co.; and O. F. Burnett, Kelso-Burnett Electric Company.

Team Work Wanted

(FROM PAGE 56)

policeman. Our remedy lies within our own exercise of industrial democracy.

Your Committee receives various letters of complaints. Most of them boil down to the manufacturers' and wholesalers' failure to establish a price differential which protects the contractor and that there "ought to be a law" of some sort to compel them to do so.

Your Committee does not share this viewpoint. We are of the opinion that the contractors have been lax in doing a selling job to establish once and for all the importance of their position in the industry to such degree that the manufacturer and wholesaler would be very eager to work with them.

Your Committee believes that contractors should sell the manufacturer and wholesaler, through sales performance, constant contact, publicity and persuasion, that the easiest, most satisfactory and most profitable way to sell their products is through electrical contractors.

This is a local job. The best place to practice industrial democracy is out in the communities—yours and mine—where our members know of the local problem and the personality of the people involved.

Local Inter-Industry Committees

With this procedure in mind we wrote each member of the Board of Governors of NECA and asked that they appoint a local Inter-Industry Committee. These local Committees would become active in promoting better understanding between contractors, wholesalers, manufacturers and utilities. Do this thoroughly and we are confident of good results.

Our business today is big business compared to what we have been accustomed to. It is a first-line business in the electrical contractor's community. It has climbed up the ladder to the professional rung. It is up to each one of us to measure up to the new requirement.

This means that we will have to expand and readapt ourselves to meet this new challenge. It means an aggressive sales force that will bring in business the year around. It means properly engineered installations; necessary equipment to do the best possible job for the least money, the best manpower available. Then publicity, advertising, personal salesmanship, to let the customers know that his shingle is out.

Cutler-Hammer Combination Starters



A UNION OF
CONVENIENCE, ECONOMY
AND WORLD-FAMOUS
ENGINEERING

Cutler-Hammer Combination Starters offer many advantages that production-minded executives and experienced electrical supervisors are quick to recognize. Combining motor control and safety switch in one compact case, they save just about half the time required for mounting and wiring separate units. They effect savings throughout their long life by providing greater convenience in operation and maintenance. They protect motors against overload but, through use of the famous Cutler-Hammer Eutectic Alloy Overload Relay, they do not needlessly interrupt production on harmless current surges. They provide the smooth trouble-free performance of Cutler-Hammer Dust-safe Vertical Contact motor control and a motor-circuit switch built to the same high standard of engineering excellence. CUTLER-HAMMER, Inc., 1306 St. Paul Ave., Milwaukee 1, Wisconsin. Associate: Canadian Cutler-Hammer, Ltd., Toronto, Ontario.



Look for these superiorities in C-H Combination Starters

Eutectic Alloy Overload Relay

This famous engineering achievement utilizes a fusible alloy with unvarying characteristics. Grips tight till the danger point is reached, then releases instantly to cut motor off the line. Resets without delay.

Dust-safe Vertical Contacts

Assure full metal-to-metal contacts. No arcing, burning, pitting or welding. No dressing or filing.

Trouble-free Safety Switch

The motor-circuit switch in a Cutler-Hammer Combination Starter is built to the same high standard of engineering excellence as the motor control.

Plenty More Features

• General purpose and NEMA

types 1A, 4, 5, 7, and 9 special service enclosures.

• Heavy-duty contactors, open and accessible. Pivoted construction and self-aligning armature eliminate sliding friction, assure positive, equalized contact pressure and quiet operation.

• Magnet coils, vacuum-impregnated, solid 100% filled. Easily accessible.

• Disconnects; side-operated safety switch; front-operated contactor type or thermal type circuit breaker.

• Low voltage control circuit from self-contained transformer.

• Vise-type main circuit fuse clips.

• Reversing or non-reversing.

• Cadmium plating or stainless steel metal parts protect against rust.

MOTOR SHOPS

L. V. PANEL FOR TRANSFORMER TESTS

A substantial proportion of the electric equipment repair work done by the Fagan Electric Company of Little Rock, Arkansas, involves the testing and rewinding of distribution transformers of the local utility company, as well as industrial customers. Hence, an important item of shop equipment is suitable high voltage test facilities.

To permit accurate testing of the range of transformers normally handled in the shop, Fagan Electric designed and built their own high voltage test panel. The totally enclosed assembly (including transformers and connections) consists of a free-standing instrument panel equipped with the necessary circuit breakers, variable voltage control and instruments; and a second panel on which are mounted the high voltage terminal insulators with hook-stick test leads. Added to the first panel is a 110-volt contactor and test leads for making polarity tests.

Two transformers, mounted behind the panel and enclosed for safety, provide the necessary test voltages. One is a 25 kva., 230 volt primary, 2,300/-13,800-volt dual-wound secondary unit. The second is a 15 kva., 2,300/33,000-

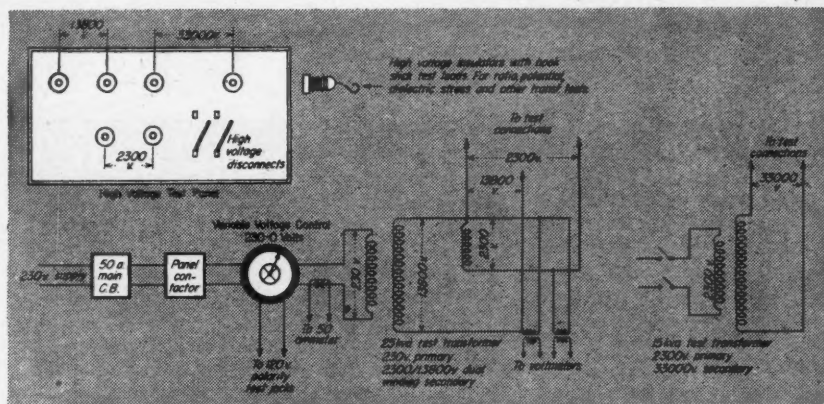
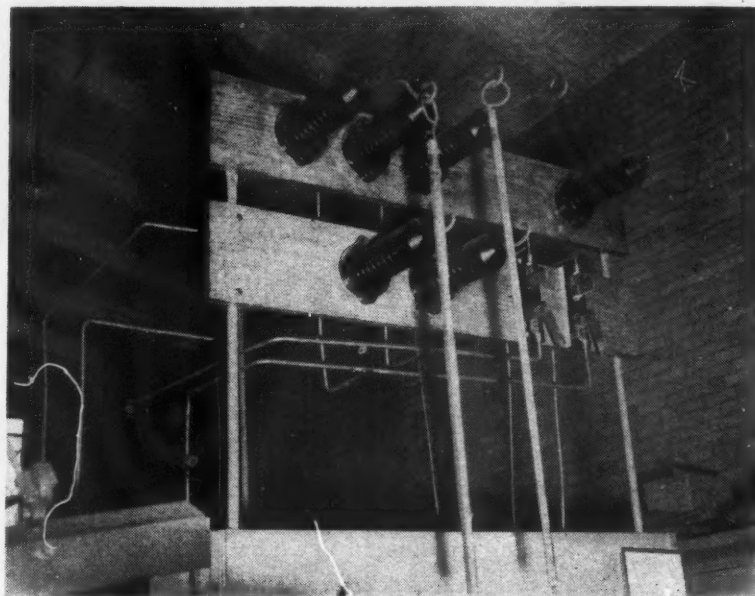


Diagram of transformer connections on the H. V. test panel in the Fagan Electric Company shop.



Hook-stick test leads add flexibility to test panel. One set of leads can be hooked over proper insulator terminals to obtain desired test voltage.

volt unit. When necessary, a third transformer is connected to obtain 66,000 volts for test purposes.

Three sets of high voltage terminals provide access to the 2,300-, 13,800- and 33,000-volt facilities. A single set of hook-stick test leads is used for all tests. The upper part of each lead is a solid copper rod with a long insulated handle and a ring on the end. The leads are merely hooked over the proper insulators for the voltages desired.

Intermediate test voltage steps are obtained by varying the feeder voltage (230-volts) with the variable voltage control on the instrument panel. Two 0-75 volt voltmeters are connected through potential transformers to the high-voltage sides of the test units.

The following scale, attached to the

instrument panel, conveniently indicates the meter readings which correspond to the more common test voltages:

Meter Reading	Test Voltage
On the 2,300-volt connection	
115	2,300
On the 13,800-volt connection	
57.5	6,900
60.0	7,200
63.5	7,620
66.7	8,000
95.9	11,500
110.0	13,200
115.0	13,800

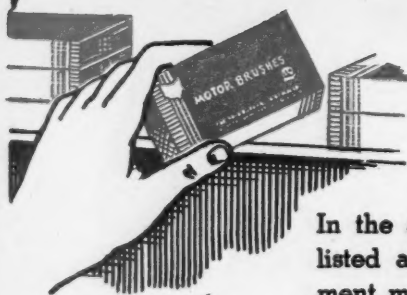
With the test facilities now in use, the Fagan Electric Company is able to accommodate transformers up to 500 kva. capacity at 33,000 volts.



High voltage test panel used at Fagan Electric Co. for making ratio, potential, dielectric stress, and other transformer tests.

CARBON BRUSHES

AT YOUR
Fingertips
WITH



OHIO COMPLETE BRUSH SERVICE MEANS IMMEDIATE ECONOMY IN YOUR MOTOR MAINTENANCE

In the above reference book, brushes are listed alphabetically by motor and equipment manufacturer's name. These brushes are carried in stock and conveniently packaged in sets because the motors on which they are used are standard small horse power types. At least 15,000 styles of motors are listed. It's a plain "Dollars and Sense" policy to carry a complete stock of brushes on your shelves ready for quick replacement. From a list of motors in your plant, select an adequate stock of emergency brushes, a few sets of each and preserve economy in your motor maintenance. Send for this complete book today! Don't Delay!

**ORDER AN
ADVANCE
STOCK AND
INSTALL
AT A
MOMENT'S
NOTICE**

CARBON BRUSHES
designed to fit
your
REQUIREMENTS

THE OHIO CARBON COMPANY

12508 BEREA ROAD • CLEVELAND 11, OHIO

REEL RACK SPEEDS COIL WINDING

T. T. Evans and son, S. V. Evans, of the Evans Motor Repair Shop, Utica, N. Y., believe in making all work jobs as simple and easy as possible. Any time they can add a machine, device or gadget to their shop layout which will improve efficiency or make work easier for their employees, they do so. Many such devices have been designed and produced right in their own shop, specially adapted to the problem at hand.

One such device that is needed in connection with any coil winder is a reel rack and adjustable wire tension attachment. Facing the need for this labor saver during the war when it was next to impossible to obtain delivery on machine products with any priority ratings available to motor shops, the Evans Shop designed and built one which is described here.

The frame work of the reel rack is made of angle iron, drilled and bolted together as shown in Fig. 1. It is about three feet wide, four feet long, and four feet high on the back, with the top side members sloping downward from the back at an angle of approximately 30 degrees. Three pairs of 2-inch conduit clamps were attached to the top sloping members, to form brackets for holding half-inch rods which in turn hold the wire reels.

A simple device was made to create tension on wire being fed to the coil winder. A 2 by 5 piece of timber was bolted to the top of the front part of the reel holder steel framework. To this was attached a 1 by 3 board, hinged at one end. Small grooves were made in the heavy base piece of wood with a



Fig. 1.—Ingenious reel rack with tension device was made of angle iron and wood by Evans Motor Repair Shop, Utica, N. Y. for simplifying and speeding coil winding.



O.K. of a Great Critic...

A WHOLE PLANTFUL OF THEM WHO BUILD MOTORS TO SATISFY EXACTING BUYERS!

Other plants may turn out *more* motors than the Star Plant. But you'll find no *better* motors . . . for when you see the Star Trademark you see the "O.K." on the efforts of hundreds of meticulous craftsmen working to critical standards.

Among them are the men who own the company. For Star's owners are born motor men, and the place to find them is out in the plant or around a drawing board, helping to make Star Motors as good as they can be.

Everybody at Star is exacting about quality . . .

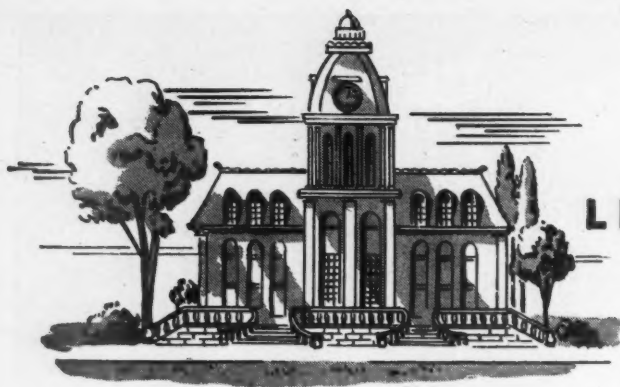
in design, materials, workmanship. There's a craftsman's spirit everywhere that words can't cover. But motor buyers who visit us always comment on it. And exacting motor users recognize that Star does things a bit better by specifying Star where a motor must be better than "good enough".

WRITE FOR 8-PAGE DIGEST. It outlines Star Motors ($\frac{1}{8}$ to 200 HP) and Generators (to 150 KW) . . . names hard-to-satisfy buyers who are long-time customers . . . tells how Star becomes the "Motor Department" for customers. Star Electric Motor Co., 219 Bloomfield Ave., Bloomfield, New Jersey.



STAR MOTORS

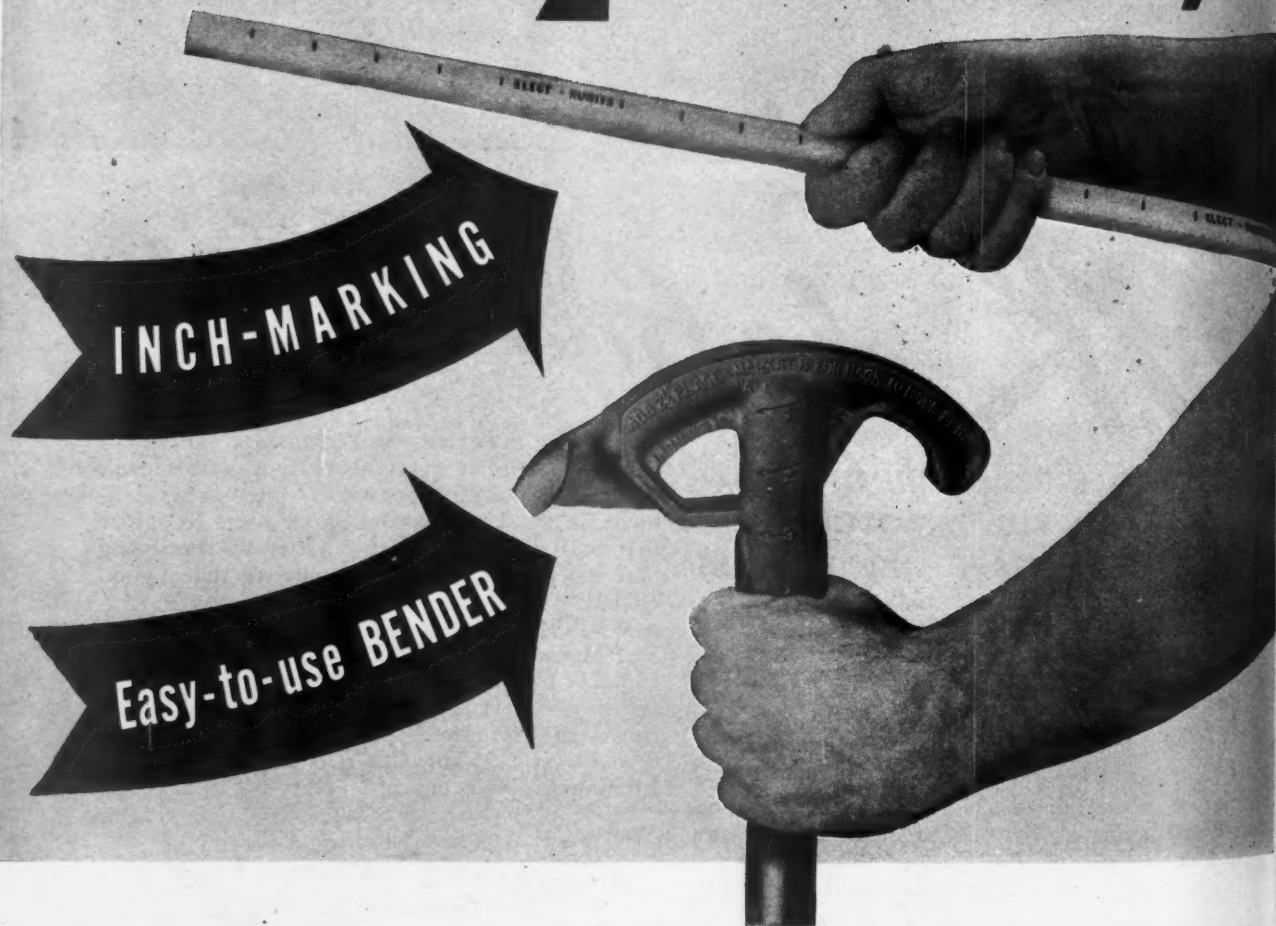
POWER PACKAGED AS YOU NEED IT



LIKE BUILDING DESIGN

Electrical Raceways

Here are **2** reasons why



SEE YOUR ELECTRUNITE DISTRIBUTOR

He is equipped to give you prompt delivery of ELECTRUNITE E.M.T. and accessories—and he can be of valuable assistance in securing materials to help you keep jobs moving on schedule.

GN

yo

have gone modern, too!



ELECTRUNITE E. M. T.

Streamlines Conduit Installations

Among the exclusive advantages of Republic ELECTRUNITE E. M. T., none are more important than the two cost- and time-saving features illustrated at the left—Inch-Marking and the ELECTRUNITE Bender.

Inch-Marking, as the name suggests, consists of a row of inch and foot marks which are clearly and accurately printed on every length of ELECTRUNITE E. M. T.

The patented ELECTRUNITE Bender was developed especially for use with Inch-Marked ELECTRUNITE E. M. T. It is a one-piece casting containing built-in instructions for use. This handy tool predetermines bends and makes them perfectly with a minimum of time and effort.

Moreover, a Bending Instruction Tag, which accompanies every shipment of ELECTRUNITE E. M. T., furnishes informative diagrams and

clear, concise directions for making all types of standard bends with the ELECTRUNITE Bender and Inch-Marked ELECTRUNITE E. M. T.

Of course, you will be interested in other ELECTRUNITE E. M. T. features, too: Its simple, compression-type fittings eliminate dirty thread-cutting . . . are tightened to strong, water-tight joints with only a pair of pliers. Its light weight takes the "back-break" and "arm-ache" out of installations and its knurled inside surface makes wire-pulling 30% easier.

Naturally, ELECTRUNITE E. M. T. is *SAFE* to use. It is inspected by Underwriters' Laboratories and approved by The National Electrical Code for exposed, concealed or concrete slab construction. For further information, write to —

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION • CLEVELAND 8, OHIO
Export Department: Chrysler Building, New York 17, New York



Republic
ELECTRUNITE E. M. T.

REG. U. S. PAT. OFF.

LIGHTWEIGHT THREALESS RIGID STEEL CONDUIT

A Message To Contractors Who Are Trying To Go It Alone



Sherman

**SOLDERLESS
LUGS**

**SOLDERING
LUGS**

**WIRE AND
CABLE
CONNECTORS**

**FIXTURE
CONNECTORS**

**GROUND
CLAMPS AND
FITTINGS**

**ELECTRICAL
TERMINALS**

**WEDGE GRIP
CONNECTORS**

A long time ago, somebody said, "We'd better hang together or we'll all hang separately." In the electrical trade, things aren't much different today. Powerful interests are opposing you, Mr. Contractor. The one way you can fight your own battle successfully is through organization.

The unions have shown what can be done through organization. They are going after what they want, and you can do the same, by joining efforts with your fellow contractors, in your local, state, and national associations.

The officers and directors of your association are smart men. They know your problems and they know the best way to attack those problems. They are putting up a great fight, but they need your cooperation and that of every other Electrical Contractor.

After all, your association is interested in the same objectives as you are. Your association is working hard and effectively to promote the professional standing of the contractor, to foster good will between employers and workers, to establish and maintain electrical codes which protect the welfare and safety of the general public, and to accomplish many other purposes of benefit to all good Electrical Contractors.

If you're not a member, join your association now. Attend the meetings and contribute your experience. You'll be mighty welcome, and you'll get a lot of good out of your association membership. Best of all, you'll know you are doing your best for your industry and the good of the general public.

H. B. SHERMAN MFG. CO.
Battle Creek, Michigan

**Support—Your Local
State and National
Associations — —**



Fig. 2.—Reel rack is mounted on wood base attached to base of coil winder. S. V. Evans demonstrates how tension on wire simplifies coil winding.

hacksaw, varying sizes to fit varying size wires. By clamping down the hinged top piece of board over a wire placed in the proper size groove, the proper tension on the wire can be created for best results in feeding the wire to the coil winder. The entire framework is bolted to two pieces of 2 by 6 wood, which in turn are attached to the wood base on which the coil winder is mounted. This is shown in Fig. 2.

In operation, it is easy to place new reels of wire on one of the half-inch rods, and lift it in place on the reel holder. Each rod will accommodate at least three reels of wire. This feature simplifies change in production when a new coil size is required to fill a rush job. The tension board can be loosened quickly, the new wire laid in the proper groove, the board lowered and clamped back in position. The operator may then attach the wire to the coil winder, make the necessary adjustments for new coil size, and begin winding.

SPECIAL MOTOR REWINDS BOOST OUTPUT

A specially designed 3 hp. winding for a 1½ hp. frame has allowed drill press motors in a middle western woodworking plant to withstand constant overloading, often in excess of 5 hp. without failure.

The winding was designed by the Arthur H. Wagner Company, Chicago motor repair shop, for motors used to power drill presses at the Wilhite Woodworking Company, Chicago. The Wilhite Company previously manufactured wooden washers to fit over the

GIVE MOTORS A LONGER LEASE ON LIFE..

WITH "TUFFERNELL"
INSULATING MATERIALS

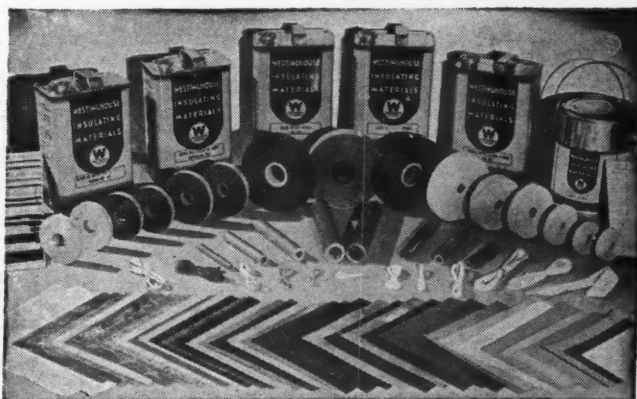


Now is the time to make sure that your electrical apparatus will give added years of service . . . without interruption . . . and at competitive efficiency. So, for choosing the correct insulation ask your Westinghouse Distributor about "Tuffernell" . . . a complete line of insulating materials.

"Tuffernell" includes all the usual insulating materials as well as DC-993, a varnish belonging to the sensational chemical family of silicones.

For complete dimensions and application data on mica, fabrics, tapes and papers, get a copy of Catalog 65-000. Write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

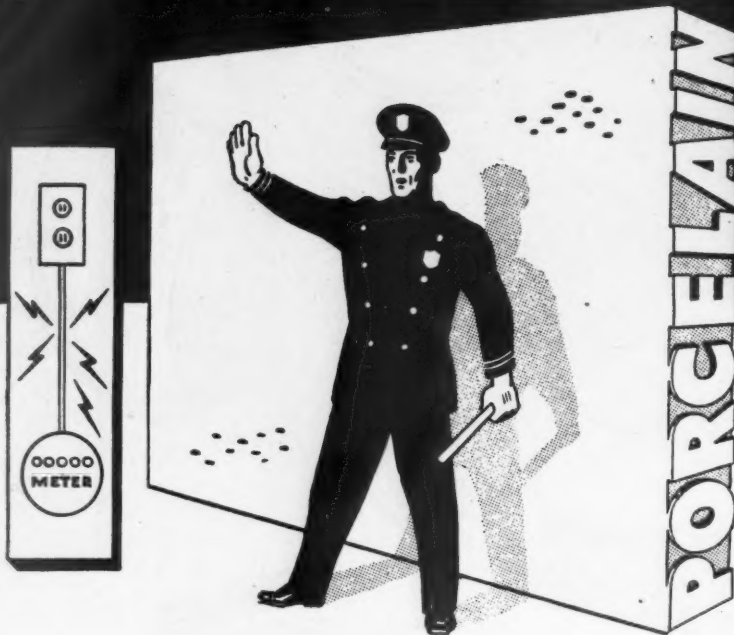
J-06366



Westinghouse Insulating Materials include a complete line of micas, fabrics, tapes, papers and varnishes.

Westinghouse 
Insulating Materials

STOP CURRENT LOSSES Between Meter and Outlet WIRE WITH **PORCELAIN**



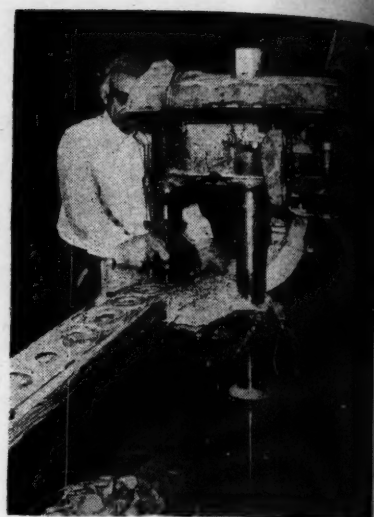
Adequate PORCELAIN Protected Wiring Systems save money every month for the consumer—and that means a dividend in goodwill for you! This savings results from the ability of adequate Porcelain Protected Wiring Systems to carry greater electric loads—preventing overloaded circuits, the chief cause of wasted current. (Current is wasted in the form of resistance when wiring circuits are overloaded.)

Any way you look at it—for safety, permanence, economy, and all-around satisfaction—you can't beat the non-metallic PORCELAIN protected way! Ask your friendly Electrical Inspector about the safety features of knob-and-tube wiring. Write for wiring manual.



PORCELAIN
PP PRODUCTS, Inc.
FINDLAY, OHIO

Wire Today for Tomorrow's Load



Output of drill presses employed by the Wilhite Woodworking Company, Chicago, to shape three-ply veneer Douglas fir washers used in packing 105 mm. shells for shipment overseas was materially increased by rewinding motors with Fiberglas insulation, enabling the motors to withstand high temperatures induced by constant overloading.

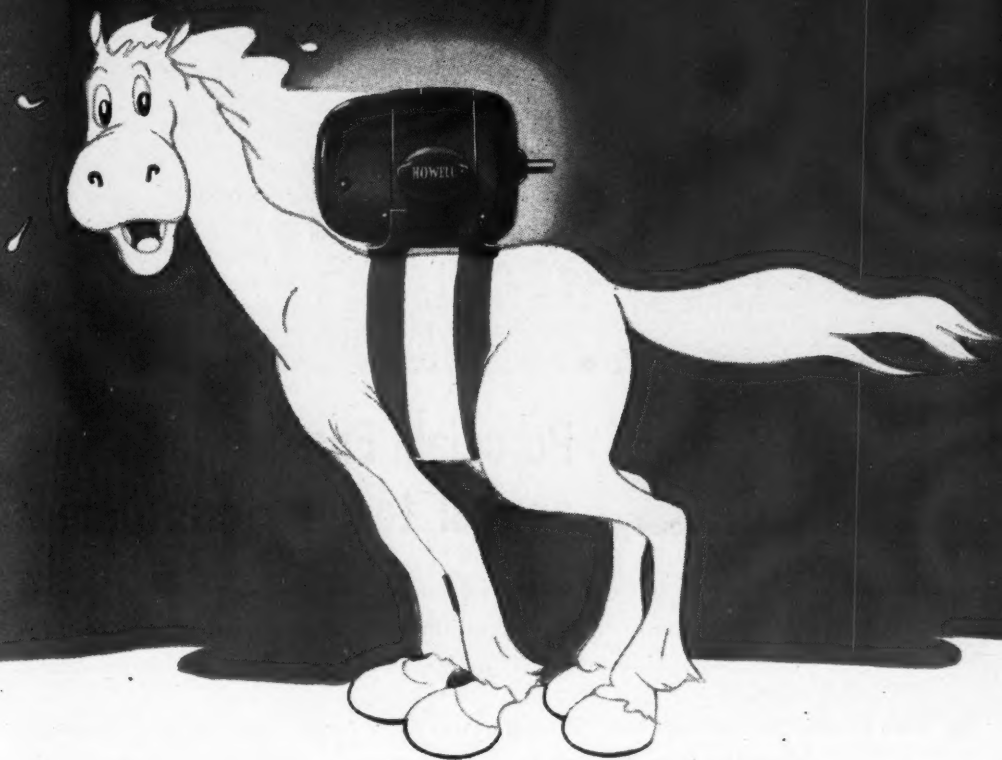
nose of 105 mm shells. Purpose of the washer, shaped from three-ply veneer Douglas fir, was to make possible a more compact packing of the shells in containers for shipment overseas.

Fiberglas insulation was used in the re-wound motors throughout. According to L. G. Young, shop superintendent of the Wagner firm, use of Fiberglas enabled the motors to withstand the high temperatures induced by constant overloading. Because of the small amount of space it occupies, Fiberglas insulation made it possible to design the 3 hp. winding for the 1½ hp. frame. Six motors were similarly re-wound. To date no motor winding failure has been reported.

The drill presses, equipped with 1½ hp. cotton-insulated motors, produced 5,000 washers per eight-hour shift, but the motors burned out on the average of every two weeks, according to H. S. Wilhite, general manager of the Wilhite Company. By uprating the motors, output of the drill presses was increased to 8,500 washers per machine per shift, with a top record of 12,500 washers.

Increased output of the presses and the elimination of motor failure not only increased production of the washers, but resulted in conservation of manpower. Only one shift was employed where two shifts were formerly required.

To obtain the same results through the use of larger motors would have meant the replacing of the existing drill presses with larger and more expensive machinery. The presses were powered by three-phase 60-cycle 220-440 volt a-c induction type motors.



HERE'S WHY I'M RED BANDED!

Years ago—1915 to be exact—we set out to build a line of motors to do specific jobs in industry.

These jobs were all what you would call “tough jobs.” They were gruelling tasks which required the precision-building of higher-quality motors. They were jobs which demanded thorough insulation and sturdy construction.

We built our motors to meet the rigid requirements of just such jobs as these. To distinguish them from other makes, we put Red Bands on them. We constantly challenged buyers to give “Red Band” Motors their tough jobs.

They did! Performance alone brought bigger and bigger sales volume. Each year, more and more industries, like yours, learned to depend on Howell quality.

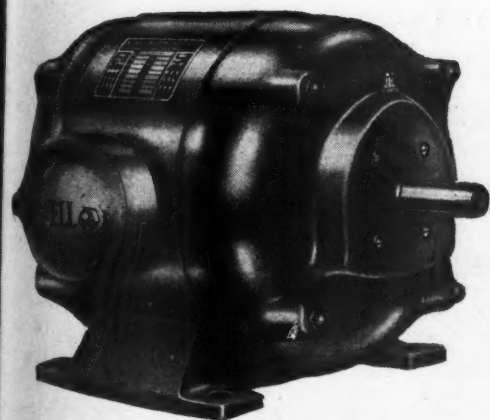
Today, modern construction of our motors does not make it practical to include the Red Bands, but their quality is the same or better than that of the motors that bore the famous Red Band.

To remind you that we are continuing our high quality construction and that we are zealously guarding our reputation we have put the Red Bands on the friendly Howell Horse.

HOWELL ELECTRIC MOTORS COMPANY

HOWELL, MICHIGAN

Manufacturers of Quality Motors Since 1915



The Howell Protected Type Motor, shown, gives complete protection against dripping liquids, metal chips and other falling particles. Completely streamlined—utilizing non-breakable steel frame—malleable or steel base—cast iron end plates and cast iron weatherproof terminal box are standard construction features. Special horizontal and vertical mountings are available. Available in sizes 5 H.P. and smaller. Other sizes and types available up to 150 H.P.

IT'S EASY TO SEE WHEN IT'S DAY-BRITE!

The DAY-LINE

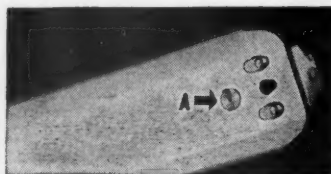


...with a *long* Life-Line

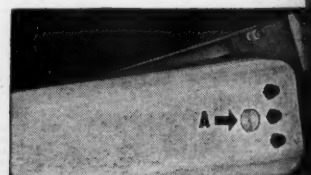
The DAY-LINE, pictured above, is a heavy-duty industrial fixture with porcelain enamel steel reflectors for unit or continuous mounting with Day-Brite "Ice Tong" hangers. Available for two or three 40-watt or two 100-watt lamps.

Porcelain Enamel Reflectors appeal to your customers

- You save money for your customer *every month* starting with the installation of Day-Brite Porcelain Enamel Reflectors because the finish, hard as glass, is not affected by age, fumes, or heat. Chipping or scratching is so unlikely he can simply forget about it.
- Your customer gets the same light diffusing quality ten or twenty years from now that he gets when Day-Brite Porcelain Enamel Reflectors are installed. The high reflection factor, maintained for years, means a long life-line of customer satisfaction with both the product and you.
- Every cleaning of these reflectors with simple soap and water, and the quick return of their original brilliance will remind your customer favorably of you. He will notice that the reflectors can be removed and replaced in less than one minute as shown by the illustrations below.



Captive wing nut, "A" (one at each end of fixture) easily loosened by hand. No tools.



How reflector is released from channel. Wing nuts can't get lost.

Consult your nearest Day-Brite Engineering Representative

DAY-BRITE LIGHTING

Incorporated

5457 Bulwer Ave. St. Louis 7, Mo.



TMs Reg. U. S. and Foreign Countries

In Canada address inquiries to Amalgamated Electric Corp., Ltd., Toronto 6, Ontario.

- Nationally distributed through leading electrical supply houses

MODERN LIGHTING

FLUORESCENTS FOR THE HOME

One of the most interesting exhibits at the Chicago Electric Association's Postwar Electric Appliance and Radio Show in the Commonwealth Edison Company's loop store, was a series of three model rooms—living room, dining room, and bed room—featuring newly developed fluorescent lighting fixtures. Sponsored by the Chicago Lighting Institute, the model lighting exhibit aroused considerable interest among the 100,000 visitors per week attending the exposition during its October-November run.

The Chicago home owners received their first glimpse of a pleasant combination of incandescent and fluorescent illumination designed for residential application. High intensity—yet comfortable—lighting was illustrated. Based on designs conceived and developed in the Commonwealth Edison Company testing laboratories by the Utilities Research Commission, the fluorescent general lighting units include 40-watt single and double-lamp fixture sections arranged in tandem, parallel and right angle assemblies. These can be mounted on the surface of the ceiling over long couches, over comfortable chairs in room corners, or directly over dining tables. All lamps are completely shielded by stippled

clear glass bottom and opaque diffusing glass side panels. Ballasts are concealed in metal enclosures in the single-lamp tandem and right angle assemblies. Concealed valance lighting illum-

inates full-draped window sections of the room.

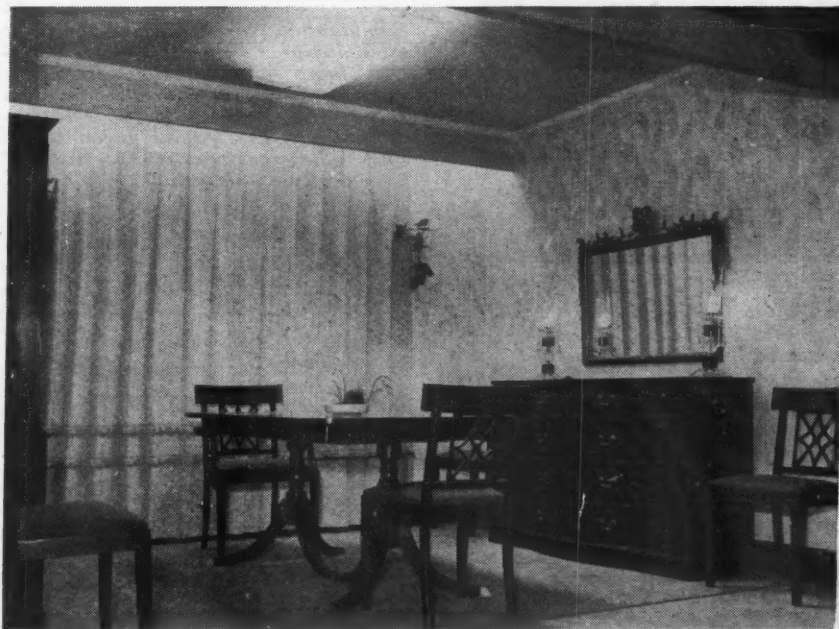
For the more critical seeing tasks of reading, sewing, etc., standard I.E.S. floor and table lamps are used in com-



Well lighted model living room illustrates use of fluorescent and incandescent lighting in the home. Average general lighting with ceiling units and combination incandescent-fluorescent portable lamps turned on is 30 foot candles. Intensity at couch varies from 30 fc. in center to 50 fc. at table lamps. Ceiling units contain a single, 40-watt, 3500 degree white lamp per section.



Tandem fluorescent unit on ceiling provides shadowless, evenly distributed light of 30 footcandle intensity providing comfortable reading even out of range of the end table lamps.



Dining room with a four-lamp, 40-watt fluorescent fixture in center. Intensity on table—50 footcandles. Three 40-watt, 3500 degree white lamps concealed behind valance illuminate full-draped window section.



**TOP
QUALITY**

Mr. Tops, the
Paragon symbol
of top quality.

POULTRY HOUSE TIME CONTROLS

Here are two first quality Poultry House Time Controls. Paragon "PS" models are designed for both morning and evening lighting, with dimming period for roosting. The Paragon Model 301 is designed essentially for morning lighting only. It is a heavy duty, industrial type time switch adaptable to poultry house lighting.



Model "PS"
for
**Morning
and
Evening
Lighting**

Model 301
for
**Morning
Lighting
Only**



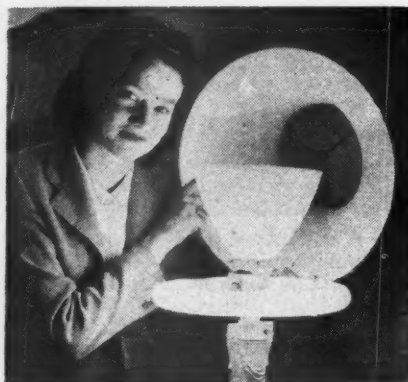
Send for *Authoritative Bulletin*

Paragon has prepared a 4-page, 2 color bulletin containing authoritative information relative to poultry house lighting control. It summarizes the recommendations of leading poultry authorities and gives complete data regarding the wide range of Paragon poultry house time switches. Send for a supply to distribute among your dealers and power companies.

PARAGON ELECTRIC COMPANY
710 Old Colony Building • Chicago 5, Illinois



Circline, 32-watt lamp enclosed in decorative diffusing glass, makes its debut as a bed room ceiling unit. Fluorescent bed lamp (not shown) provides 50 footcandles at reclining reading distance. Bridge lamp illustrates use of new sunlamp bulb that fits into conventional lamp socket. General illumination (including floor lamp not in photo) is 15 footcandles.



Combination incandescent-fluorescent table lamp. Circline 32-watt fluorescent lamp provides the soft direct lighting needed for critical reading and sewing tasks. Lamp is 100-watt conventional I.E.S. unit. Incandescent bulb eliminates sharp contrasts and provides color warmth.

Combination with the new 32-watt circular fluorescent lamp which provides the direct illumination component. The circular fluorescent lamp—suitably shielded by glassware—also made its debut as the decorative center ceiling fixture for the bed room.

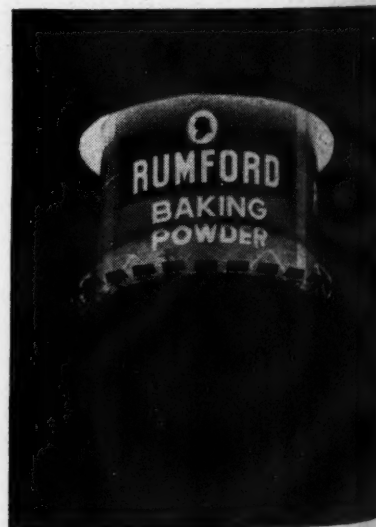
FLUORESCENT LAMPS FLOODLIGHT TOWER DISPLAY SIGN

Visible over a large area of Providence, R. I., is a large tower located at the plant of the Rumford Baking Powder Company. Advantage has been taken of the visibility of this tower, and

of its shape, for year-round, day and night advertising.

The tank at the top of the tower is shaped to resemble the Company's packaged product. It has been painted in the same colors used on package labels. The sides of the tower have been floodlighted with fluorescent lamps which accent it at night and cause it to stand out in sharp contrast and spectacular beauty against the black background of darkness.

A total of 30 weatherproof flood-



Tank on tower resembling Rumford Baking Powder Company's packaged product is floodlighted effectively by thirty 15 watt fluorescent lamps. Towering above the Company's plant at Providence, it is visible both night and day over a wide area.

Certified Ballasts

...builder of lasting customer good will!



Yes sir, fluorescent fixtures equipped with Certified Ballasts can do a lot to increase customer good will. Because they not only mean satisfactory performance longer . . . but also fewer service troubles for your sales representatives.

And here's why:

1. **Certified Ballasts are quality built . . .** made to definite specifications . . . to assure better lamp performance. Leading fluorescent tube manufacturers recognize this—since with Certified Ballasts in a fixture, they will guarantee lamp performance.
2. **Certified Ballasts are E.T.L. checked.** Sample ballasts are thoroughly tested by famous Electrical Testing Laboratories, Inc., before they are certified as meeting Ballast specifications. Random samples are periodically rechecked at the laboratory and at the factories.
3. **Certified Ballasts help assure top performance** in fluorescent lighting units that use them . . . dependable service, too. *And your customers know it.*

How about taking advantage of this for your fixtures? Give them the prestige, dependability and assurance of continuing customer satisfaction that Certified Ballasts can provide!

Certified Ballast Manufacturers

MAKERS OF BALLASTS FOR CERTIFIED FLUORESCENT LIGHTING FIXTURES

CHICAGO TRANSFORMER CORP.
3301 Addison St., Chicago, Illinois

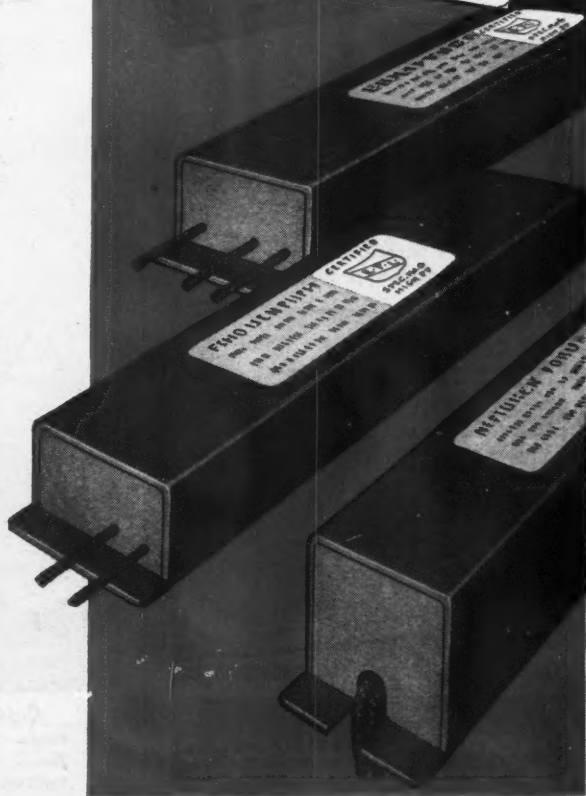
DONGAN ELECTRIC MFG. CO.
2987-3001 Franklin St., Detroit, Mich.

GENERAL ELECTRIC CO.
Specialty Transformer Section
1435 Broadway, Fort Wayne, Ind.

JEFFERSON ELECTRIC CO.
Bellwood, Illinois

SOLA ELECTRIC CO.
2525 Clybourn Ave., Chicago 14, Illinois

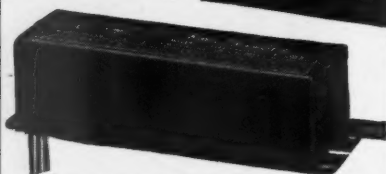
WHEELER INSULATED WIRE CO.
378 Washington Ave.,
Bridgeport, Conn.



STANDARDIZE Transformer Installations with

ACME

for
**LONG LIFE
TROUBLE FREE
PERFORMANCE**



FLUORESCENT LAMP BALLASTS
Complete range of sizes for all lamp applications. Quick start and standard designs. Bottom lead, end lead and universal lead types.

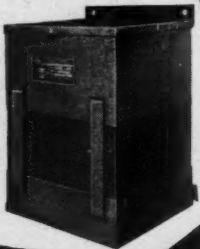


**NEON SIGN
TRANSFORMERS**

A variety of mounting styles, types and designs to meet every installation limitation. Underwriters Laboratories approved. Performance tested.

AIR COOLED POWER TRANSFORMERS

From 1/10 KVA to 50 KVA, single and 3 phase up to 2400 volt primary. Sturdy construction. Simplified design. Write for bulletins.



THE ACME ELECTRIC & MANUFACTURING CO.
CUBA, N. Y.

Acme Electric
TRANSFORMERS

lights are installed around the bottom perimeter of the tower tank to provide uniform lighting on the painted area. Because of a hand railing which surrounds the tower, the floodlights had to be carefully located to cause the shadow of the hand rail to fall between the words "baking" and "powder".

Each floodlight contains one 15 watt 3500° white fluorescent lamp. Floodlights are made weatherproof by a gasketed clear glass cover. Three No. 10 wires in 3/4-inch conduit from a machine shop at the base of the tower supply current to the floodlight units. A small booster transformer was also installed in the machine shop to supply 118 volts at the units, since normal voltage in the plant is 110 volts. The floodlights, which are G. E. Novalux type, wiring, transformers and control were installed by the J & H Electric Company of Providence.

C. C. FLUORESCENT IN HARDWARE STORE

Blazing the trail to increased sales in the huge postwar market for hardware and supplies is Little Frank's, hardware store in Springfield, Mass. Appreciating the true value of light in selling, it was their desire to highlight the merchandise, and to provide a high level of general illumination throughout the store. They wanted the lighting equipment to be inconspicuous, also demanded a color quality of light

suitable for showing hardware to its best advantage.

With this predetermined conception of the *lighting result* which they wanted, they presented this problem to their electrical contractor, Leo Heyman, of the Heyman Electric Company. Working closely with the general contractors, E. F. Carlson Co., Inc., a complete installation of cold cathode fluorescent lighting was made.

The store is 35 feet wide, 90 feet long, and has a 14 ft. 6 in. ceiling height. Wall cases line both sides and the rear of the store. Two lines of floor display stands are located in the center of the store.

The store owners cooperated in the design of the lighting system as a whole by agreeing to paint the entire ceiling and side walls down to the top of the wall cases in a near-white, having a higher reflection value.

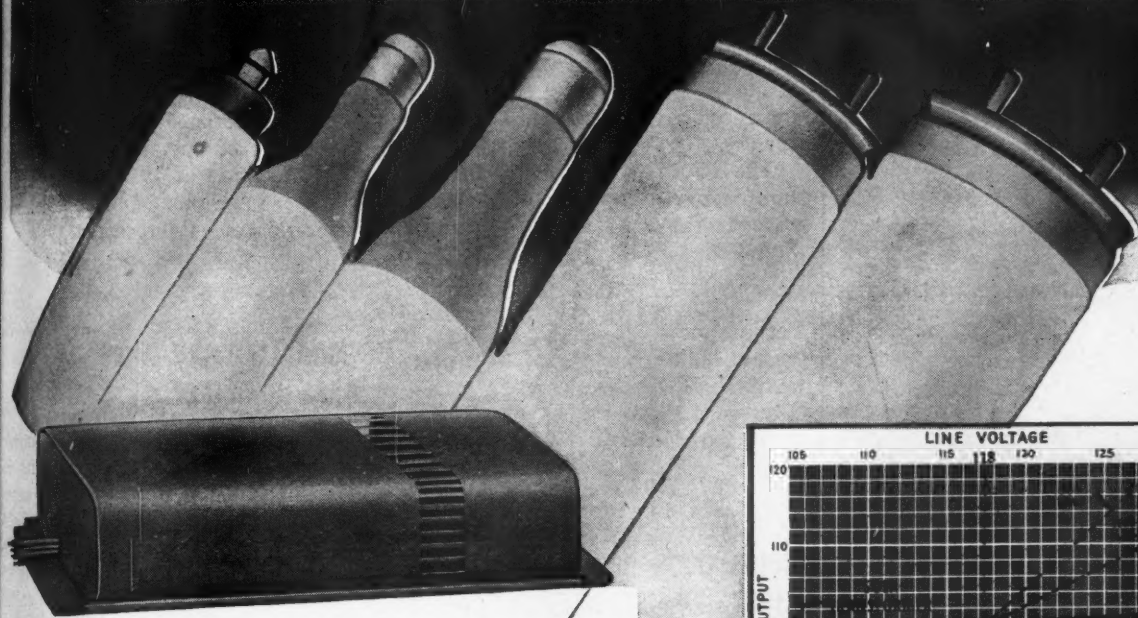
The *planned lighting* layout for this installation consists of wall case lighting to highlight the merchandise displayed on the counter under the wall cases and in the wall cases, overhead ceiling mounted equipment to provide general illumination, and show window lighting in two show windows. Only cold cathode fluorescent light sources are used throughout the store, including the show windows.

Wall case lighting consists of two continuous rows of tubes, installed at the front of the top of the wall cases. There are 200 linear feet of wall cases, and the tubes are so installed that they are concealed from view. Signs over the tops of cases are of the luminous type; uniformly lighted by the continuous rows of tubes.



Cold cathode fluorescent lamps are used to light show windows, wall cases and main sales area in Little Frank's, hardware store in Springfield, Mass. Intensity is over 45 footcandles average. Job was engineered and installed by Heyman Electric Company, Springfield.

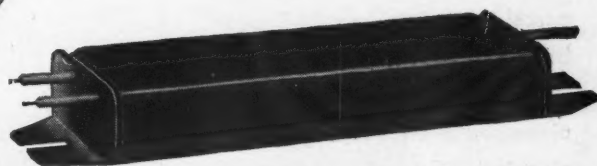
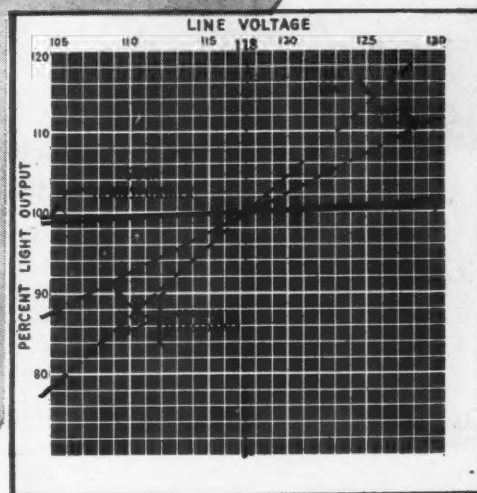
Whatever the FLUORESCENT light source, there is a SOLA TRANSFORMER or BALLAST to meet every requirement



Selection of the proper light source for particular applications of fluorescent lighting is no longer a simple assignment. Lighting research and development have produced a wider choice, each possessing its own qualifications and requirements.

But regardless of the light source selected there is a SOLA Fluorescent Ballast or Transformer that has been engineered specifically for the requirements of each type of fluorescent lighting.

Many of these fluorescent lamp auxiliaries have been designed around the new SOLA Constant Voltage principle. This patented circuit provides regulation to the lamp that was never before possible. With this new added feature, lumen output of lamps can be maintained at calculated levels regardless of fluctuations that are constantly occurring in the primary voltage supply. This maintenance of lumen output represents a definite saving to the user and positive insurance to the lighting engineer of constant footcandles on the working surface.



Whatever your lighting requirements, consult SOLA engineers—they have the answer to the many fluorescent lighting problems that are daily confronting the lighting engineer.

+ + +

SOLA fluorescent Lighting Transformers incorporating the Constant Voltage principle are covered by United States Patents Nos. 2,143,745—2,212,198—2,346,621.

Lighting SOLA Transformers

4
Important Bulletins
available on
request

COLD CATHODE	Bulletin	JCC-104
COLD CATHODE	Bulletin	JCC-107
FLUORESCENT	Bulletin	JFL-108
FLUORESCENT	Bulletin	JFL-110

Transformers for: Constant Voltage • Cold Cathode Lighting • Mercury Lamps • Series Lighting • Fluorescent Lighting • X-Ray Equipment • Luminous Tube Signs
Oil Burner Ignition • Radio • Power • Controls • Signal Systems • etc. SOLA ELECTRIC COMPANY, 2525 Clybourn Avenue, Chicago 14, Illinois

Electrical Contracting, December 1945

YOUR BEST BETS



PORCELAIN...

The Quality Insulator

P&S...

Quality Porcelain Sockets

On that job that requires porcelain sockets, use P&S and be sure of a trouble-free installation through the years. P&S pioneered in the manufacture of electrical porcelain and their fifty years of manufacturing experience assures you of wiring devices that will stand up on the job.

Sold Thru Electrical Wholesalers

Send for your P&S Catalog today.

PASS & SEYMOUR, INC.
SYRACUSE 9, N. Y.

ous line of lamps. An indirect component of light is obtained through an opening over the top of the lamps.

Two continuous lines of equipment, each line consisting of four rows of fluorescent tubes installed end to end, provide general illumination, and light for merchandise displayed on the center display counters. The ceiling equipment, surface installed on the high ceiling, is inconspicuous because of its height from the floor, and utilizes the light colored ceiling as a reflecting surface.

The resulting intensity of illumination is over 45 footcandles average, measured after 100 hours of operation. Show window lighting is in excess of 100 footcandles. All tubes used are 25 mm. diameter, eight feet long except in show windows where they are custom built to length, and are operated at 120 milliamperes current density. Transformers are 12,000 volt secondary type, concealed from view, and so installed as to be readily accessible.

CONTINUOUS ROW FLUORESCENT LIGHTS OFFICE AREA

Typical of the new trend in lighting is this continuous row fluorescent installation. It is in the office of the Wm. R. Warner Co., St. Louis, Mo., manufacturers of pharmaceuticals.

The installation consists of eight rows of 17 units per row, connected end to end. These continuous rows are spaced ten feet apart, and mounted ten feet from the floor. The ceiling height is twelve feet, and the room is 82 feet long by 70 feet wide.

The fixture selected for this installation, the Wakefield "Grenadier" unit, is a direct lighting type. It is designed

for use with two 40 watt lamps, and is open at top and bottom. Lamps are shielded on each side of the unit by a luminous curved reflector of low surface brightness, and on the bottom of the unit by metal louvers extending both along and across the bottom opening.

The area of this room is 5740 square feet. Lamps and auxiliaries use a total of 12,920 watts, or an average of 2.27 watts per square foot. The lighting intensity averaged 44 footcandles after 800 hours of operation. This results in an average of 19.4 footcandles per watt per square foot, and a coefficient of utilization of 44 percent.

GOOD LIGHTING AIDS BEEF GRADING

Because the price of beef is entirely dependent on the graders' visual inspection, good illumination is a necessity for this work. With improved seeing conditions, busy graders can inspect meat faster, thus speeding shipments, and increasing the annual capacity of coolers.

The Wimp Packing Company, Chicago, has relighted its holding-cooler, using fluorescent lighting to provide a special quality of illumination which they have found to be excellent for the job. The important factor in grading is to distinguish between "corn-fattened" beef and "grass-fattened" beef, since "corn-fattened" beef brings a higher price. Standard 3500° white fluorescent lamps aid in distinguishing the differences between these two types of beef. The inherent long source of fluorescent lamps provides shadow-reducing, and diffusing qualities which



Forty-four footcandles of "in-service" illumination are obtained from continuous row fluorescent lighting in this office of the Wm. R. Warner Co.

HOLDENLINE CHAN'L-RUN

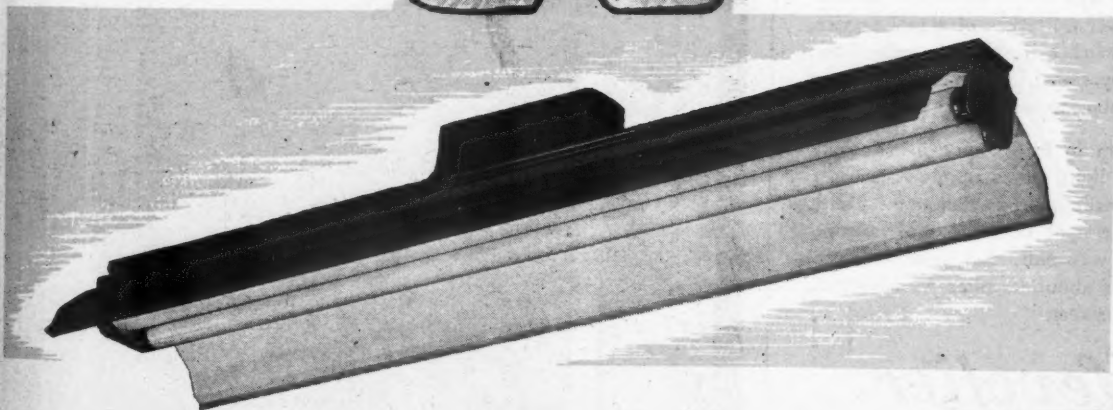
They seem to look alike and they do . . . but . . .

This is precisely the point . . . it pays to analyze details in lighting fixtures . . . because it's in the details that HOLDENLINE'S skill at planning for greater ease of maintenance and for greater speed of conversion to continuous-run become evident.

Details such as roomy channels for a quick shift of wiring, easy removal of end plates and adap-

tation of joining-straps to insure the unity and strength of each run save the contractors and users time and money. The strong, steel plates which hold the butt-on sockets so that breakage is eliminated . . . and the other details described in catalog bulletin B-45 are clearly indicative of a product built to serve . . . and serve you better. Find out about them.

See your wholesaler or
write direct for Bulletin B-45



HOLDENLINE COMPANY

Pioneers in Fluorescent

1960 EAST 57TH STREET • CLEVELAND 3, OHIO



SWITCH TO..

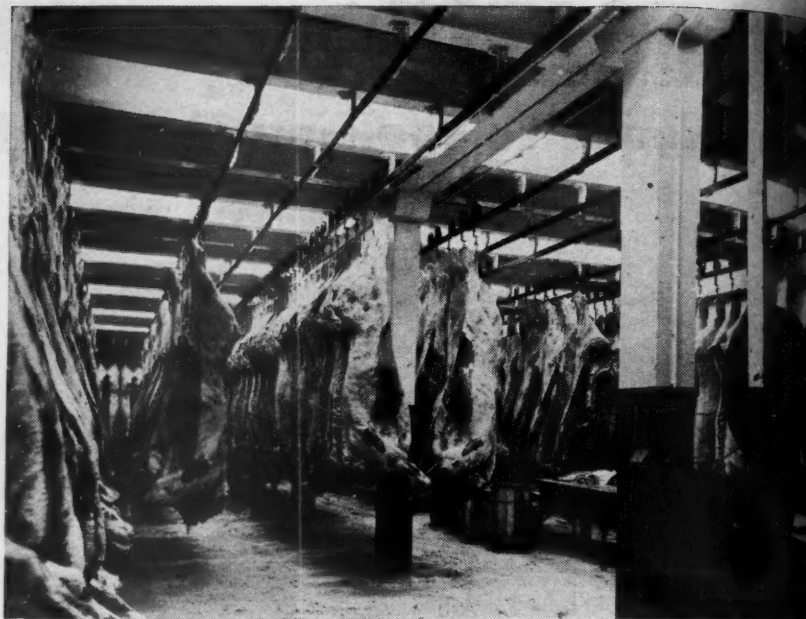
Safety

That's where Levolver Switches come in. In tests they have taken over 168,000 pulls — on and off — without trouble or a miss. Over a lifetime of actual service. Levolver switches are hand assembled and individually tested, and listed by Underwriters' Laboratories.

Use them in Fluorescent installations, individual light, or F. H. motor control. They are made in 3 to 10 ampere capacity, single pole, two circuit, series multiple and three way pull. Ask your Electrical Wholesaler about Levolver Switches . . . Switch to Safety.

Levolver

McGILL
MANUFACTURING CO., INC.
Electrical Division
VALPARAISO, INDIANA



Fluorescent fixtures using two 3500° white 40 watt lamps each are recessed in ceiling troughs to light this holding-cooler of the Wimp Packing Company, Chicago. High light utilization and good color quality aids in beef grading.

make all portions of the beef carcasses visible to the grader.

Wimp's holding-cooler, shown in the accompanying photograph, is 85 feet long by 50 feet wide. The ceiling height is ten feet. Eleven continuous open troughs, each eight inches deep and painted white, are provided in the ceiling on seven foot spacings. In each trough there are four Guth fixtures spaced eleven feet on centers, containing two 40 watt lamps each. The total

wattage is 4400 watts, or an average of 1.04 watts per square foot. The resulting intensity is 25 footcandles average, 30 inches above the floor.

Carcasses are hung from monorails located close to ceiling. This necessitated close spacing of troughs to provide uniform lighting in upper area.

Temperature in this room is automatically maintained at 35° F., and relative humidity at 80 percent. Instant start ballasts were used in all fixtures.



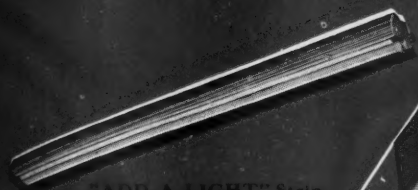
Vapor-proof fluorescent units flush-mounted in the semi-enclosed spray booths provide a maintained intensity of 40 foot candles for spraying B-29 engine parts with an anti-corrosion protective coating at the Dodge-Chicago plant, operated by the Chrysler Corporation. Fixtures, equipped with two, 40-watt, 3500 degree white lamps, are installed in a row, 12 inches end-to-end; 20 inches from the work conveyor; and 7-ft., 6-in. above the floor. Free air circulation in semi-enclosed area permits use of vapor-proof units.

Announcing "ADD-A-LIGHT"

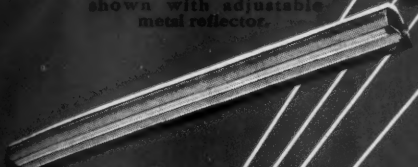
THE NEW MOE-BRIDGES
FLUORESCENT
"PACKAGE MERCHANDISE"
LIGHTING UNITS



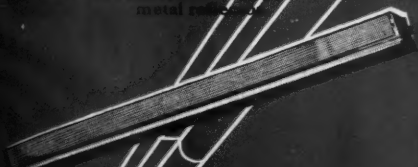
The "ADD-A-LIGHT" Strip... which in addition to being a complete fluorescent lighting unit within itself... is the basis for all adaptations shown in left column. Once a single unit is connected... additional units may be extended any distance required (see male and female plugs above). Basic strips and attachments come in 24, 48, and 96 inch lengths.



"ADD-A-LIGHT" Strip shown with adjustable metal reflector.



As Assembled with fixed metal reflector.



With decorative fixed reflector.



Decorated with an ornamental louver attachment.



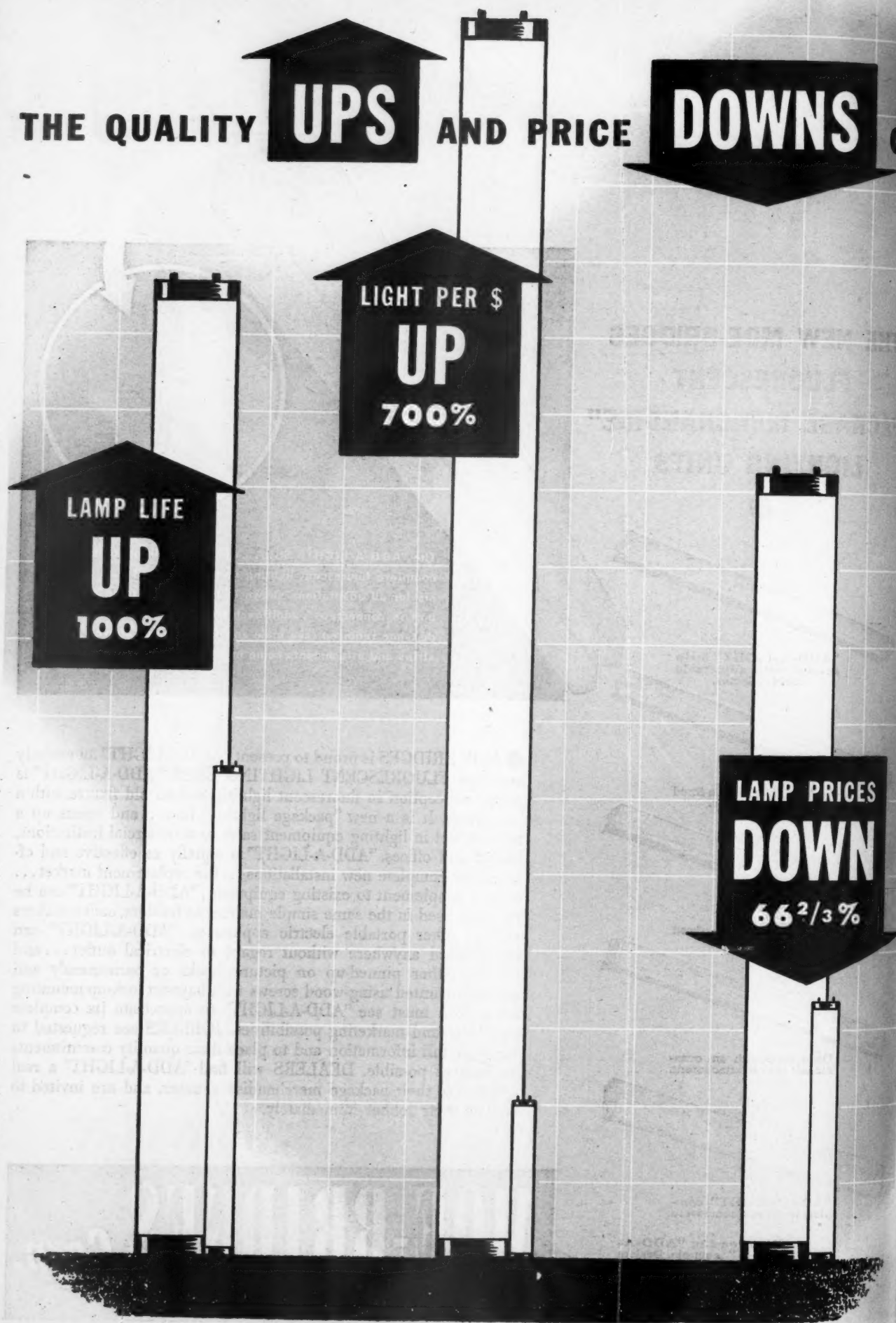
"ADD-A-LIGHT" complete with plastic enclosure.

Warehousing "ADD-A-LIGHT" is simple. Dealers and Jobbers primary stock consists of required basic strips plus sufficient attachments for varied demands.

● MOE-BRIDGES is proud to present "ADD-A-LIGHT" an entirely new type FLUORESCENT LIGHTING UNIT. "ADD-A-LIGHT" is a new conception in fluorescent lighting, not an old fixture with a new dress. It is a new "package lighting" line... and opens up a new market in lighting equipment sales to commercial institutions, homes and offices. "ADD-A-LIGHT" is equally as effective and efficient for complete new installations... the replacement market... or as a supplement to existing equipment. "ADD-A-LIGHT" can be merchandised in the same simple manner as toasters, coffee makers and all other portable electric appliances. "ADD-A-LIGHT" can be installed anywhere without regard to electrical outlet... and can be either pinned-up on picture hooks or permanently and quickly mounted using wood screws with bayonet lock-up mounting holes. You must see "ADD-A-LIGHT" to appreciate its complete simplicity and marketing possibilities. JOBBERS are requested to write for full information and to place their quantity commitments as soon as possible. DEALERS will find "ADD-A-LIGHT" a real addition to their package merchandise counter, and are invited to contact their Jobber immediately.

MOE-BRIDGES Corp.
SHEBOYGAN, WISCONSIN

THE QUALITY **UPS** AND PRICE **DOWN** OF



Westinghouse finer fluorescents

Within the period from 1939 to 1945, Westinghouse fluorescent lamp prices have been reduced by two-thirds. Average rated lamp life is up 60%—in some cases 100%! The average efficiency (lumens per watt) has increased 40%. Altogether, improvements in Westinghouse Fluorescent Lamps add up to a light-per-dollar increase of 700%!

Today as always, Westinghouse buys the best raw materials obtainable . . . subjects the lamps to continuous and intensive testing and inspection all during manufacturing. Westinghouse research continues to explore means of building in further product improvements.

That's why the name "WESTINGHOUSE" on a Fluorescent Lamp package means you can count on getting the fullest benefit from years of experience, research and consequent product improvements.

That's why you can sell Westinghouse Fluorescent Lamps with complete confidence that your customers will get full satisfaction from every purchase.

Westinghouse Electric Corporation, Lamp Division, Bloomfield, New Jersey

Westinghouse presents John Charles Thomas, Sunday, 2:30 P.M., E.S.T.—NBC.
Tune in Ted Malone, Monday through Friday, 11:45 A.M., E.S.T.—ABC.

Westinghouse
PLANTS IN 25 CITIES OFFICES EVERYWHERE
LAMPS FOR SEE-ABILITY

©1945, Westinghouse Electric Corporation

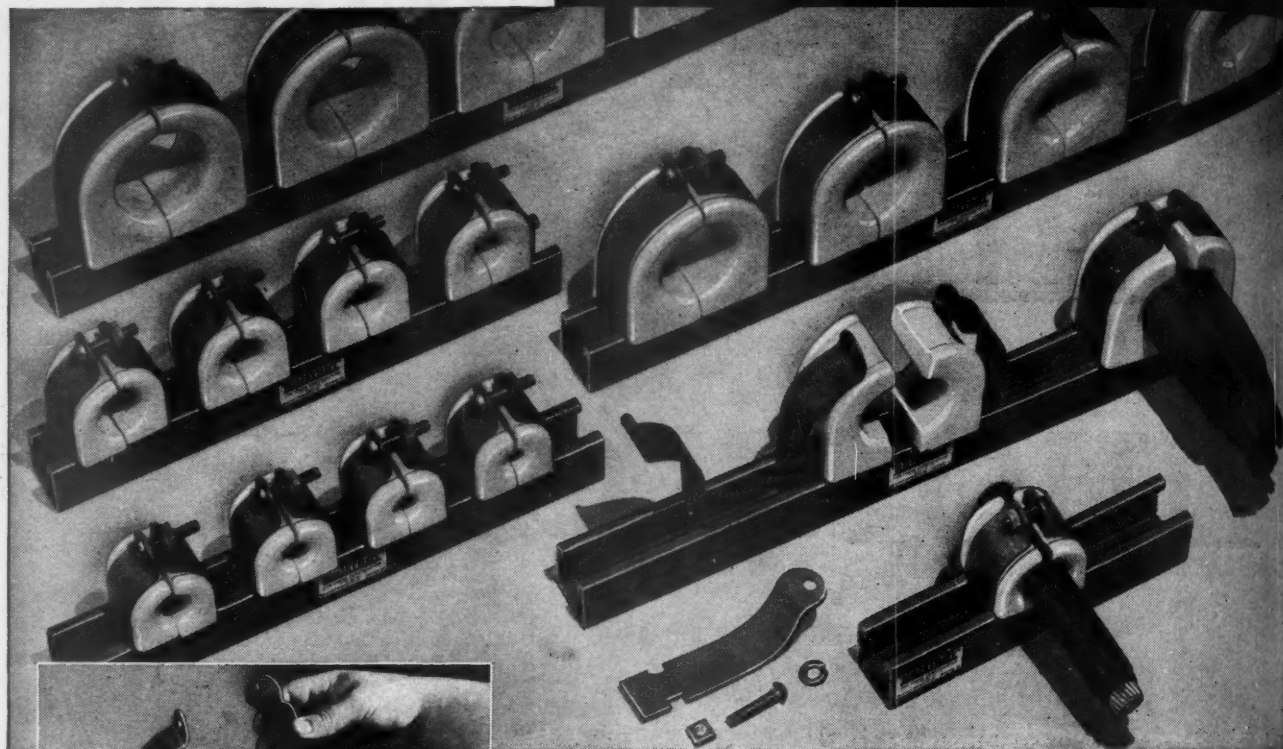
NEW!

UNISTRUT

CABLE CLAMPS

No holes to drill!

Shift 'em at will!



1

How cable clamp straps are inserted.

2

Insulators in position.

3

One bolt tightens clamp, locks it to support.

— SHIPMENT — NOW! —

Simply locate the new **UNISTRUT** Cable Clamp (Porcelain or Maple) at proper point on the **UNISTRUT** support—tighten one bolt. That's all! No holes to drill!

A "NATURAL" FOR RECONVERSION JOBS!

UNISTRUT Clamp is locked tight to standard **UNISTRUT** support—the two parts of Insulator are locked together—the cable firmly secured—all by one bolt!

EVERDUR bolts, nuts and lock washers furnished with clamp assembly.

Clamps can be shifted or additional clamps added any time.

You cut **UNISTRUT** supports to length desired, right on the job, with a hacksaw.

Build Electrical Supports "On-the-Job"

UNISTRUT hollow-square members with spring-held nut attachments make all kinds of electrical supports—frames,

hangers, motor bases—right on the job—no holes to drill, no riveting or welding!

Representatives in all principal cities
Stocks in Chicago, Detroit, Los Angeles, St. Louis, San Francisco, Atlanta, Seattle, Kansas City, Houston.

UNISTRUT PRODUCTS CO.
1013 W. Washington Blvd. • Chicago 7, Ill.

Please mail prices on (porcelain) clamps for in. dia. Cable. (Made to fit all cables or conduits from 1/4" to 4 1/2" O. D. in multiples of 1/8".)

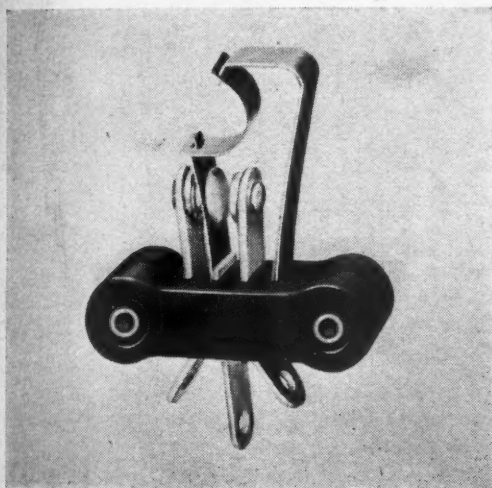
Name
Address
Company
City State

THESE ANNOUNCEMENTS of new equipment are necessarily brief—for more detailed description, sizes, prices and other data write to the manufacturers' advertising departments, tell them in what issue of **ELECTRICAL CONTRACTING** you saw the item and they will send full details to you.

EQUIPMENT NEWS

Snap Switch

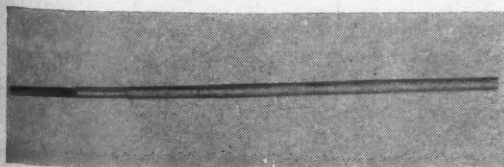
A new type smaller size open blade snap switch has been announced. It is known as Model M and is for vertical mounting, in multiple as well as singly. Operating blade, center blade and rolling spring are made of a heat-treated beryllium copper to withstand high capacity and long life. Overall dimensions are approximately 1½-in. by 1½-in. by ½-in. Standard operating pressure is 6 to 10 oz. It is furnished for single pole, normally open, normally closed and double throw circuits. Rated at 15 amps., 125 volts a-c and ½ hp. 110 a-c. Acro Electric Company, 1338 Superior Avenue, Cleveland 14, Ohio.



ACRO SNAP SWITCH

Appliance Lead Wire

A new Deltabeston appliance lead wire for use where both heat and moisture are a problem has been announced. This wire is insulated with a moisture-resisting cellulose acetate wrap next to the conductor, a layer of felted asbestos and a lacquered glass braid over-all covering. It is designed for use with appliances and equipment such as sterilizers, etc., where medium high temperatures and moisture are to be found. Its maximum operating temperature is 125 deg. C. The wire is available in white, red, green, blue, brown or black. General Electric Company, Appliance and Merchandise Department, Bridgeport 2, Conn.

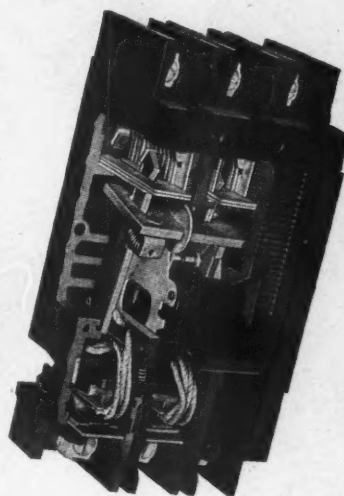


G-E APPLIANCE LEAD WIRE

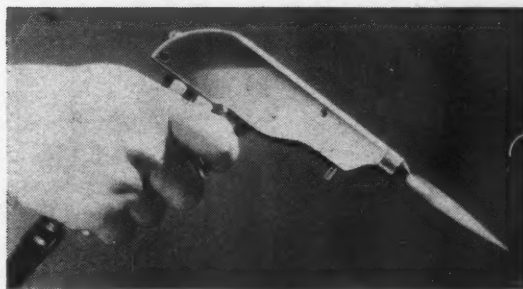
Circuit Breaker

The new ML2 100 ampere frame circuit breaker has been announced. Ratings are 15 to 100 amperes—600 volts a-c, 50 to 100 amperes 250 volt a-c and d-c, two and three pole. Dust resisting sheet steel enclosures with front operated handle are available for three and four wire solid neutral applications in addition to two and three pole devices. Weatherproof, dust-tight and explosion resisting enclosures are also available for Class

I Group D and Class II Group G hazardous locations. This breaker is also furnished for panelboards. Square D Company, 6060 Rivard Street, Detroit 11, Mich.



SQUARE D CIRCUIT BREAKER



CENTURY GAS GUN

Automatic Gas Gun

This gas gun is a self-lighting, self-extinguishing acetylene torch. The gas ignites with the pull of the trigger and extinguishes on its release. Variations in flame, with a temperature range of from 950° to approximately 2,000° F are obtained by adjusting the pressure regulator. The gun is an efficient torch for soldering, silver-soldering, fine, light brazing and lead burning, as well as aluminum soldering, sheet metal work, low-temperature welding, tinning, paint removing and general equipment repair work. Century Aircraft Co., 5601 W. Century Blvd., Inglewood, Calif.

SPECIAL PURPOSE OUTLETS



THESE Outlets serve special purposes *in addition* to those served by ordinary receptacle types. Their *extra-utility* has durable basis in right design, rugged parts, reliable workmanship.

No. 7707,— Clock Hanger Outlet: Provides electrical connection and mechanical support for clock. No. 7792,— Weather-proof Receptacle with cadmium-finished brass plate, metal cap and weather-tight rubber mat. No. 7797,— Floor Outlet, with 2 threaded brass covers; one to shield plug cap and one to close outlet when not in use. No. 7750,— Fan Hanger Outlet: Provides mechanical support for fan, with electrical connection. No. 1914,— Duplex 2-circuit Receptacle; one circuit always "ON" for appliances, the other to be switch-controlled as for lamp circuit.

Ask for complete catalog listings of the types here shown as representative, as well as standard outlets and switches.

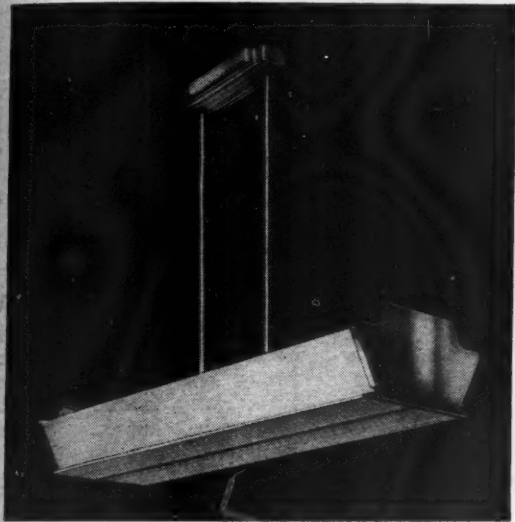
DISTRIBUTED THROUGH ELECTRICAL WHOLESALERS

ARROW ELECTRIC DIVISION

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY, HARTFORD, CONN., U. S. A.

Fluorescent Fixture

This new A-2440 Permaflexor fluorescent fixture is known as "The Van Buren." It utilizes four 40 watt, T-12 fluorescent lamps on an operating voltage of 110-125, 60 cycle a-c current; also available in 50 cycle. It has an overall length of 48-1/9 inches, overall height of 7 3/4 inches and an overall width of 15 1/2 inches. The side panels are Skytex Satinol glass; bottom is formed of two pieces of Skytex clear glass supported by a T-bar center strip. Luminaire may be surface or suspension mounted as individual units or in continuous rows. Pittsburgh Reflector Company, Oliver Building, Pittsburgh, Pa.



PITTSBURGH FIXTURE

Instrument

These new Universal Type hand tachometers, Type U, have five ranges and are direct reading. Instruments are small in size with a three inch dial. The tachometers are non-magnetic, of the centrifugal type, direct reading, well damped, which cuts out oscillations. Four models are available for all speeds between 30 and 48,000 rpm. Herman H. Sticht Company, Inc., 27 Park Place, New York 7, N. Y.



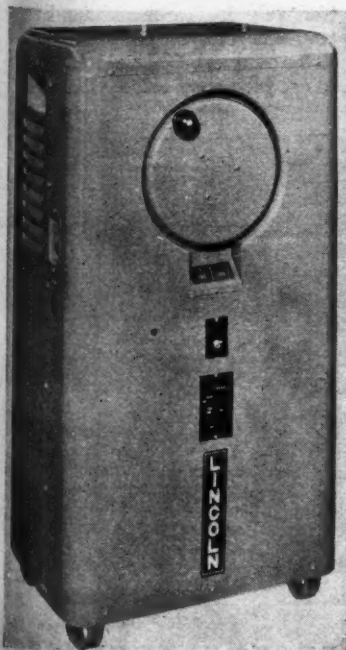
STICHT TACHOMETER

Fluorescent Lamp

A new low brightness 40 watt 4500° white fluorescent lamp in the 100 watt size has been announced. A starting stripe, running lengthwise along the tube of the new lamp, facilitates starting. It is recommended for use in store, auto showroom, office and drafting room lighting. Technical data pertaining to the new F-lamp: instant starting; mogul bi-pin base; shorted base pins; standard mogul bi-pin lamp-holders, as used with the 100 watt T-17 bulb, can be employed; regular instant starting ballast designed for 40 watt lamps is applicable; regular preheat 40 watt ballasts can be employed with the new SS-400 "Jack Rabbit" split second starter when available. General Electric Lamp Department, Nela Park, Cleveland, Ohio.

Welder

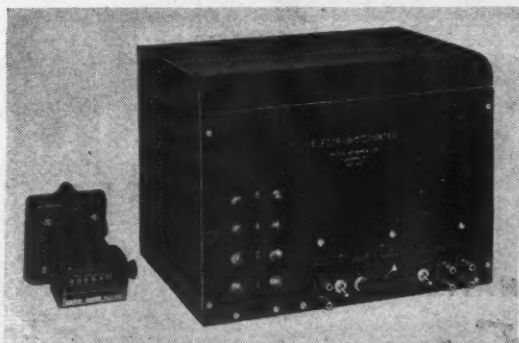
A new welder for farm and shop use has been announced. It is called the "Fleet-Arc Jr." and is for 230 volt, single phase power lines. It has a maximum input current of 35 amperes and can be used with the standard 3 kva power transformer provided by the power company. Current range is from 20 amperes at 20 volts to 180 amperes at 25 volts welding duty. It will handle electrodes ranging from 1/8-in. to 5/16-in. diameter. It incorporates the "Arc Booster" which provides quick, easy arc starting. Current control for the welder is of the separate adjustable reactance type which is varied by turning a hand wheel. Adjustment is continuous over entire welder range of from 20 to 180 amperes. The Lincoln Electric Company, Cleveland 1, Ohio.



LINCOLN WELDER

Electronic Counter

This electronic high speed counter is particularly applicable for counts exceeding 10 cycles per second, and in installations where mechanical counters would wear out prematurely because of the high speed continuous operation. Used alone as a two-decade instrument, the maximum count capacity of the electronic counter is 100. A tube-operated relay is provided for cases where the quantity to be counted exceeds 100. The relay has a single pole, double throw contact which is brought out to terminals on the front panel of the unit, and operates once for each 100 counts. An electro-mechanical counter may be connected in series with these terminals and an appropriate external power source, such as the a-c line. It operates from 115 volts, 60 cycle, a-c power line. Potter Instrument Company, 136-56 Roosevelt Avenue, Flushing, N. Y.



POTTER ELECTRONIC COUNTER

GIVE YOURSELF

A MERRY, PROFITABLE CHRISTMAS



Westinghouse
Electric Supply Company



Westinghouse Electric Supply Co.
Box 25, Wall Street Station—40 Wall Street
New York 5, New York

Gentlemen: Please send me the new Westinghouse "Home Wiring Handbook". I enclose \$1 in full payment.

Name.....
Company.....
Address.....
City and Zone.....
State.....

Circuit Breaker

To complete its line of general purpose magnetic circuit breakers in the 50 amp. frame size, a three-pole breaker with three trip units that act immediately on short circuit or dangerous overloads has been added. These circuit breakers have a true inverse time delay in a hermetically sealed unit which allows passage of harmless current surges. Continued overload, however, opens the breaker in time inverse to the ratio of the current. The three trip units open simultaneously if an overload or short circuit occurs in any one leg. The breaker is designed for service on 120/230 volt a-c or 250 d-c, of 50 amperes maximum. Overall dimensions are 5½ in. long, 2½-in. high and 3-in. wide. Heinemann Circuit Breaker Company, 132 Plum Street, Trenton, N. J.

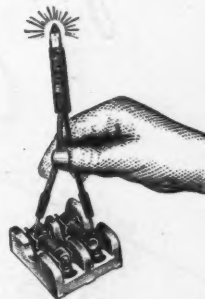


HEINEMANN BREAKER

be used in laboratories or on production lines where it is necessary to measure and test in widely scattered locations. A change in line voltage from 90 to 130 volts produces a change of less than three percent in meter reading at mid-scale. Line voltage is 115 volts, 60 cycles. Communication Measurements Laboratory, 120 Greenwich Street, New York 6, N. Y.

Tester

A new all purpose Ne-O-Lite electric test-lite is for use by radiomen, electricians, maintenance men, and mechanics. It is a handy trouble shooter for testing electric appliances, locating blown fuses, testing a-c lines, polarity of a-c or d-c, tracing ground line in a-c circuits, as a radio frequency indicator, spark plug and cable tester. Glow of neon lamp tells if circuit is broken. It tests voltages from 60 volts a-c to 550 volts a-c or d-c by variable light intensity. Ne-O-Lite Mfg. Co., Rockford, Ill.



NE-O-LITE TEST-LITE

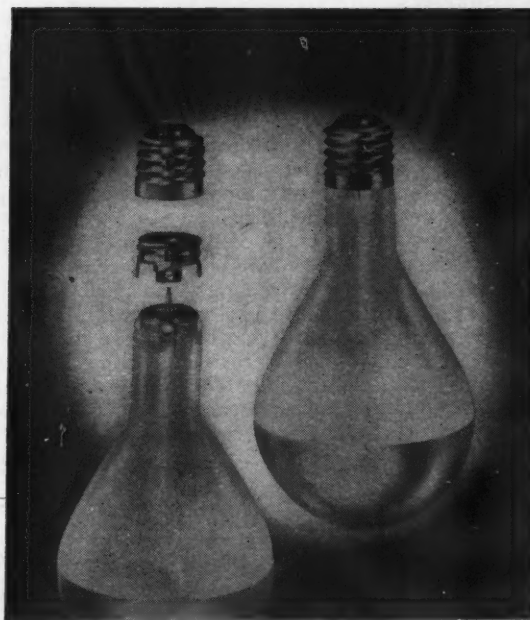
High Speed Relay



STEVENS-ARNOLD RELAY

This new Millisec relay is a hermetically sealed sensitive relay capable of speeds up to 1000 operations per second. A glass envelope surrounds all moving parts and protects them from moisture, dust or corrosive fumes. With this type of construction, sensitivities down to ½ milli watt are possible. Ratings up to 5 amperes can be obtained. Closing time can be less than one mill second. The

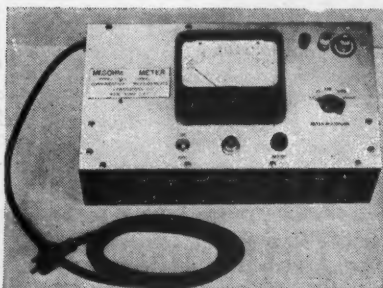
outside dimensions of the 115 volt a-c 1 ampere rating are three inches high and one and one-half inch base diameter. Stevens-Arnold Co., Inc., 22 Elkins Street, South Boston, Mass.



WABASH-BIRDSEYE LAMPS

Instruments

The new model 15000 Megohm meter has a range from 400,000 ohms to 100,000 megohms in five ranges on single scale four inch meter. It offers protection against atmospheric conditions where precise testing is required. It can



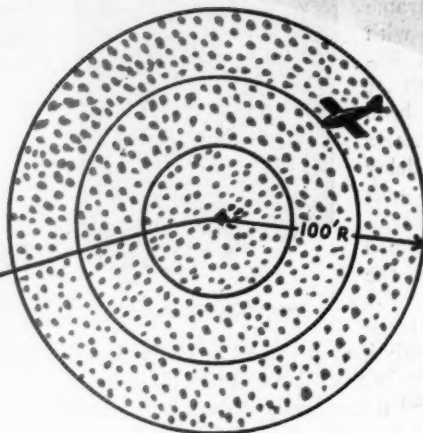
CML MEGOHM METER

Lamps

The Superlok construction is now standard on all large lamps in this line. The new construction eliminates base cementing and neck strapping, and consists of a threaded collar screwed into and notch-locked to the base, with its collar claws gripping the neck of the glass bulb. This gives a permanent lock. All standard-line lamps from 300 watts and upward, all reflector lamps and industrial infra-red heat lamps will have this base. Wabash Appliance Corporation, 345 Carroll St., Brooklyn 31, N. Y.

A SECRET NO LONGER

*Jefferson's part
in
Connection
With*



RADIO PROXIMITY FUZE Now Can Be Told

The veil of secrecy that shrouded one of the most important factors in the war just past, can now be lifted. This development, the Radio-Actuated or Radio Proximity Fuze, has been placed second only to the Atomic Bomb in importance and scientific development.

In one of the darkest moments this Fuze halted the German drive in the Belgium counter attack, helped break Jap air power in the Pacific, and in England finally stopped the buzz bombs that Germany frantically released prior to the end of the European War.

Jefferson Electric's contribution in connection with this device can now be revealed. Also credit, which was withheld due to the utmost secrecy of the project, now can be given to the skilled and loyal workers, and the inventive genius of the engineers and production experts who worked so untiringly.

One of the vital requirements was a safe operating switch that would insure against detonating the shell as it left the gun but still operate at the precise moment desired. The time between leaving the gun and firing in most instances is measured in tenths of seconds. Improper timing in the fuze of a shell results in premature detonation, commonly referred to as muzzle bursts, and is hazardous to the gun crew.

To obtain reliable operation with many different types of projectiles a switch design was developed jointly by personnel of Jefferson Electric Company and Applied Physics Laboratories of Johns Hopkins University. The result was a switch 0.315" in diameter and 0.530" long—not only remarkable because of the small size but because it was actuated by centrifugal force of the spin of the projectile rather than by the usual tilt action.

No less than 12 classes of mercury switches (all smaller than a seamstress' thimble) were made to suit the various types of guns in which Radio Proximity Fuzes were eventually used. While developing these sensitive, small mercury switches was a major accomplishment—the mass production to high standards of uniform quality and accuracy was, if anything, a greater feat. This proved again Jefferson Electric's manufacturing skill, producing—as with its transformers, ballasts and fuses—to fixed high standards at mass output rates.

Jefferson is proud to relate the success in the development of this hitherto unthought-of device—of the constant improvements made, and of the staggering rate of production attained in so short a time.



Because of the secrecy of the entire VT Fuze project, the Navy "E" Award for excellency was withheld lest it draw unnecessary attention to the plant. Now the Award with 3 stars has been made.

Jefferson Electric Company
BELLWOOD (SUBURB OF CHICAGO) ILLINOIS

In Canada: Canadian Jefferson Electric Co. Ltd., 384 Pope Ave., Toronto, Ont.

INDUSTRIAL ELECTRIFICATION

ENGINEERING • INSTALLATION • MAINTENANCE

High Frequency Heating—I

The realm of high frequencies played a significant part in America's war production miracle and will continue its role in peacetime mass production industry. This first of a series of articles reviews the fundamental principles and theory of high frequency heating.

By Dr. H. B. Osborn, Jr.

Director of Research, TOCCO Division
The Ohio Crankshaft Company
Cleveland, Ohio

MUCH has been written describing the underlying principles which control the heating of metals by high frequency currents. Theoretical considerations involving the role played by hysteresis and eddy currents cannot be dismissed too casually. Since magnetic materials lose their magnetism at a temperature below that used for heat treating, heating for forging, etc., and non-magnetic substances such as carbon, aluminum, copper, and brass respond readily to induction, as do the non-magnetic steels, the heat generated due to hysteresis is therefore probably of negligible importance, and that resulting from the eddy currents is the controlling factor. Thus any material which is capable of conducting a current, when placed within the confines of a conductor carrying alternating current, will become heated. Specifically chosen frequencies of 960, 1920, 3000, 9600, and upward of 100,000 cycles are being used extensively at this time.

The high frequency currents mentioned above, carried through an inductor designed to produce a specific heating result, generate an electromagnetic field within the space it encircles and induce a flow of current in any conducting material placed close enough to have the magnetic flux lines cut through it. The intensity of the field is greatest at the midpoint of the width of the inductor and near its inside face. The inductively heated part has thus become the secondary of a simple transformer wherein the inductor is the primary. Much of the mystery which apparently enshrouds the understanding of the principles of induction heating processes may be

cleared away by thinking of it as "induced resistance heating." Since the substance which carries the induced current has the ability to act as a conductor, it also has an electrical resistance to the flow of energy. We may then compare induction heating to straight resistance heating and establish it as I²R heating. That is, there is a flow of current (I) and a resistance to the flow (R) which, combined, are responsible for the generation of heat. However, the unusual characteristic of high frequency heating upon which all surface hardening applications depend is its tendency to concentrate on the surface of the conductor through which it flows. This phenomenon, called skin effect, is a function of frequency. Other factors being equal, the higher the frequency the shallower the depth of penetration. The limitations of this relationship are discussed in detail later.

When the temperature of an inductively heated magnetic steel bar arrives at the critical point, all heating due to hysteresis ceases and that due to eddy currents continues at a reduced rate. The rate of heating decreases with time as the electrical resistance to the flow of current increases with temperature. Since the entire action goes on in the surface layers, only that portion is affected. The original core properties can be maintained, and surface hardness secured by quenching when complete carbide solution has been attained.

Continued application of power causes an increase in depth of heating, for, as each layer of steel is brought to temperature, the current density shifts to the layer beneath which offers a lower resistance. Additional depth results from heat by conduction with longer time of heating.

It is obvious that the selection of the proper frequency and the control of power and heating time make possible the fulfillment of any desired specifications of surface hardening or through-heating for heat treating, annealing, normalizing, brazing, forging or forming.

There are certain relationships between frequency and diameter or thickness of stock treated upon which may depend the selection of the specific frequency to be used for a particular application. Currently, however, it has been found that more than 95 percent of all induction heating problems can be solved successfully by the use of energy of 9600 cycles or less. Regardless of frequency there is a broad overlapping which permits the use of all types of high frequency equipment to be used on many identical jobs and the selection evolves from a matter of economics.

All induction heating equipment consists of an inductor, quenching auxiliaries if needed for hardening, suitable transformers and capacitors, automatic timing controls, and a high frequency generator. In addition, provisions are made for handling the parts intermittently or continuously, depending upon production requirements and heating specifications.

The inductor may be a single turn of copper to fit the piece to be heated,

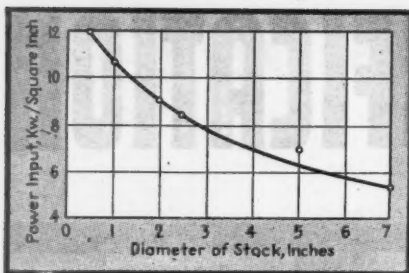


FIG. 1—Minimum power input recommended per unit of surface area for various diameter stock necessary to maintain depths of hardness usually associated with frequencies employed. Complete carbide solution dependent upon response of prior structure.

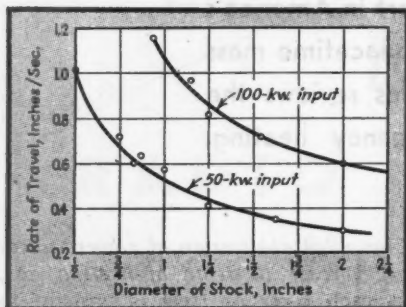


FIG. 2—Rate of travel of cylindrical stock through inductor (inches per second) for various diameters at 50 and 100 kw. input to an inductor 3/4-in. wide and coupled to work with approximately 1/8-in. air gap necessary to maintain depths associated with frequencies used.

or several turns of copper tubing shaped for the same purpose. Careful design is essential at this point to insure maximum efficiency. However, symmetrical inductors may be used to heat unsymmetrical objects because of the natural tendency of the high frequency current to follow the contour of the piece. The quenching medium is supplied through the inductor by means of orifices which are an integral part of it. The same timing device which controls the heating cycle operates an electric quench valve and controls the quenching cycle to the same degree of accuracy and also indexes parts in and out of the inductor when necessary.

Fixtures for holding parts and necessary inductors are specially designed, but are adjustable and adaptable to a wide variety of parts. Furthermore, the change from one fixture and inductor assembly to another takes but a few minutes, since the mounting positions of the equipment are generally standard. The change involves no more effort than change of a fixture on a machine tool. A single induction heating unit may be used for economical processing of hundreds of different parts.

Automatic control and accuracy are

keynotes in induction hardening from two standpoints. First, because of precise design of equipment, there is automatic positioning, assuring exact locations of hardened areas (more than one area can be treated simultaneously), and automatic control of heating, quenching, and indexing cycles to within 0.1 second accuracy. Second, this control makes each heating operation and treated object an exact duplicate of all others processed with the same setup. Further, total elimination of human error avoids the usual variations and mistakes so characteristic of manual control.

Frequency, Diameter and Penetration Depth

Numerous equations have been presented involving the use of Bessel's functions and hyperbolics which attempt to establish a formula permitting calculation of minimum optimum frequencies for specific work. While acceptable from a theoretical standpoint, such equations do not prove correct in actual practice. For example, such equations would indicate the need for frequencies of several hundred thousand cycles for processing of 1/2-in. diameter stock whereas, actually, stock smaller than this is being efficiently heated with 9600 cycles. There is, however, a relationship between frequency and diameter. A piece of 1/2-inch diameter stock processed with 2,000 cycles would heat substantially through its entire cross section and permit little if any surface hardening, whereas with 9600 cycles

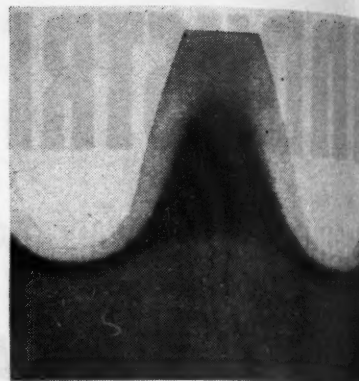


FIG. 3—Contour hardened 28-in. diameter, 5-in. face, 1 1/2 pitch gear. Frequency used was 9600 cycles. Note tough core in each tooth and 55 Rockwell "C" wear resistant surface around outside, including root.

a hardened depth of 0.08 inch is generally obtained and even shallower depths with excessive power inputs per unit of surface area or with higher frequencies. A piece of 1/4-inch diameter stock cannot be effectively heated to hardening temperature with 2000 cycles. This diameter requires 9600 cycles for sufficient temperature for metallurgical transformations to take place, and surface hardening dictates even higher frequencies. A piece of 1/8-inch diameter stock heats poorly with 2000 cycles and only to annealing temperatures with 9600 cycles. This diameter requires frequencies above 100,000 cycles for through hardening. Surface hardening of material of these dimensions is not considered practical.

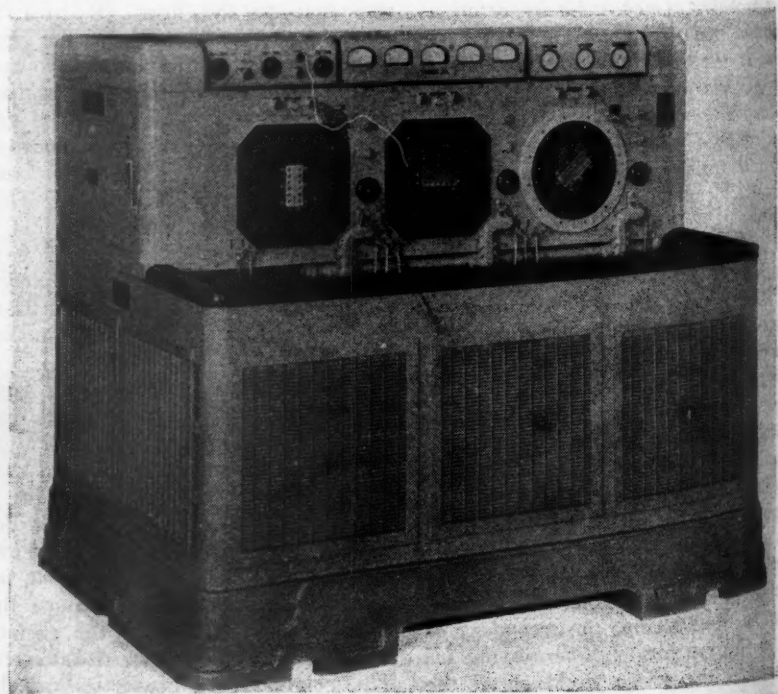


FIG. 4—Motor-generator induction heating unit. Three-station machine for multiple operation, generator and all controls self-contained. Size range up to 200 kw. at 9600 and 3000 cycles.

The depth of penetration of the induced electrical energy for a bar subjected to high frequency energy for hardening (temperature approximately 1500 degrees F.) is approximately defined by the following equation:

$$(1) \quad D = \frac{4}{F}$$

Where: D = Depth of penetration of electrical energy-inches.
F = Frequency in cycles per second.

Unfortunately, however, this factor of depth has no physical significance, since it assumes that time is zero. Since no metallurgical transformation can take place in zero time, the depth of penetration of hardness will always be considerably in excess of the above calculated depth when time assumes a significant value, for heat flows by conduction from the surface to layers beneath as previously described.

Assuming reasonable metallurgical response of non-heat-treated structure, the following table shows the absolute minimum depths of hardness which should be considered for production work:

Frequency Cycles Per Second	(2)	
	Approximate Minimum Practical Depth of Hardness Inches	Approximate Theoretical Depth of Penetration of Electrical Energy Inches
3,000	0.060	0.035
9,600	0.040	0.020
120,000	0.030	0.006
500,000	0.020	0.003
1,000,000	0.010	0.002

The foregoing depths of hardness data represent actual results obtained with structures which respond very readily to heat and are values noted with both single and progressive methods of treatment with power input considerably greater than the theoretical depths calculated from equation No. (1). Obviously, the diameter of the stock must be sufficient to offer a reasonable core since, for example, the flow of heat is so rapid in a piece of steel that regardless of frequency or power, material of less than 1/2-inch diameter cannot be surface hardened. A similar condition exists with tubing. If we are hardening such a part, the wall thickness should be at least twice the depth of hardness anticipated. Although other factors such as the relationship of wall thickness to diameter assume importance in such instances, it is not considered appropriate to discuss them here.

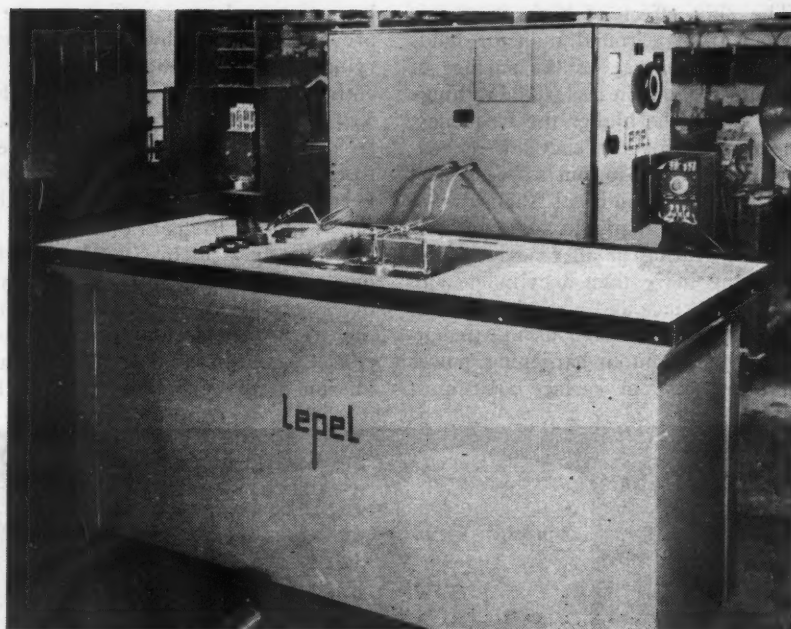


FIG. 5—Spark gap high frequency heating unit complete with work table. Note readily attachable work coils—in this case for hardening of gears.

Fullest advantage of the skin effect of high frequency heating is obtained only if the surface area can be brought up to hardening temperature in a few seconds. To do this we must maintain certain minimum values of power input per unit of surface area; otherwise flow of heat by thermal conduction will result in too great an increase in the depth of hardness. Fig. 1 shows suggested minimum values of power input per unit of surface area necessary to maintain the depths of hardness usually associated with each particular frequency. Note that on extremely small diameters power inputs of 30 to 40 kw. per square inch of surface area and frequencies of well above 100,000 cycles are generally required.

To minimize the power requirement needed for processing of long areas, a simple expedient of progressive heating and quenching is usually employed. In this case the work passes progressively through the inductor and directly into a spray quench emerging from the bottom of the inductor block. The selection of the rate of travel of various diameters depends somewhat on the width of the inductor, but Fig. 2 will serve as a guide for attaining depths of hardness noted in table No. 2 limited, of course, by a rate of metallurgical transformation. Time cycles for single area processing are established generally on a basis of 30 to 35 kw.-seconds per square inch of surface area. From the above data and curves we are able to establish approximate processing cycles for surface hardening applications which, however, must be modified depending

upon the micro-structure and depth of hardness specified. Obviously, depth of heating can be controlled within limits by varying our power input and heating time as can the microstructure. Due to the space limitations of this article, we cannot go into details on this subject.

For brazing or forging work where deep heating of sections is necessary, we generally introduce power of the order of 2 kw. per square inch of surface area on 1/2-inch stock, 1 kw. per square inch on 1-inch stock, 1/2 kw. per square inch on 2-inch stock, or roughly a kilowatt input per square inch of surface area which is the reciprocal of the diameter in inches. Obviously, modifications of these factors are necessary depending upon uniformity of cross section, shape, and many other variables.

Energy conversions show values of from 5 to 15 lbs. of stock heated per kilowatt hour of high frequency energy input depending upon temperature. It has been a common misconception that vacuum tube oscillator frequencies are needed for non-magnetic material. This is not true since copper, brass, bronzes, aluminum, magnesium, etc. are heated at the same energy conversion rate regardless of frequency. The only item of importance is the relationship of diameter to frequency, as previously discussed. Progressive heating of tubing is unquestionably the most efficient application for induction heating, particularly when the wall thickness approaches the same order of magnitude as the depth of penetration of the electrical energy.

The skin effect of high frequency current from a round inductor holds the induced energy to the surface of the object being heated. Other things being equal, the higher the frequency, the greater this tendency to concentrate on the surface, but as we depart from perfect cylindrical surfaces we are unable to maintain this uniform depth of heating in all cases. A gear is nothing more than a cylinder with distorted surface and while higher frequencies are advantageous in attempting to obtain contour hardening, power input per unit of surface area must

be maintained at a sufficient rate to prevent heat flow by conduction carrying hardness essentially through the entire cross section of the tooth (Fig. 3). Limitations of the power available from high frequency equipment therefore limit such processing to small gears. Further, perfect contour hardening is limited to gears of less than approximately 7 pitch, regardless of frequency. On finer pitches, hardening of essentially the full cross section of the teeth results, and gears so processed perform satisfactorily in transmission and other assemblies. For

large sprockets and similar parts it is generally more practical to use a formed inductor to process one tooth at a time.

High Frequency Generation

There are three sources of high frequency current which today find commercial acceptance for induction and dielectric heating. The first two, the motor-generator and spark gap oscillator, are confined to the induction heating of metals only. The third, the vacuum tube oscillator, is used for both induction and dielectric heating.

The motor-generator sets, commonly referred to as rotating equipment, are produced as standard units up to 1500 kw. output at frequencies of 960, 1920, 3000, and 9600 cycles. Such units are powered by synchronous or induction motors operating at either 1800 or 3600 rpm. from standard 60 cycle power lines. The 3600 rpm. equipment used in the production of 9600 cycles is at present confined to operation from 60 cycle lines although the same equipment on 50 cycle lines gives 8000 cycles. Special equipment is now being designed for use on 25 cycle lines. The operating efficiency of the motor-generator sets runs generally at 75 to 80 percent and, due to there being no power limitation, can be used for hardening extremely large parts if necessary. Actually, motor generator units can be, and are in many instances, paralleled for high power output (Fig. 4).

Smaller units of the spark gap oscillator type (Fig. 5) provide frequencies of the order of 100,000 to 400,000 cycles and are rated at, for example, 7½, 15, 32, and 40 kw. input. The output from the largest machine is approximately 25 kw. which, therefore, generally limits this type of equipment to use on small parts if the heating time is to be kept low and full advantage taken of the high frequency method. Efficiency averages 45 percent.

Frequencies of several hundred thousand cycles are developed by means of vacuum tube oscillators, but power output is again a limiting feature with 20 and 50 kw. output appearing as standard equipment. Frequencies generally used for induction heating run from 350,000 to 500,000 cycles with a few special units at 1,000,000 cycles. For dielectric heating, oscillators running from 2 to 30 megacycles represent the major type with a few units used at 100 megacycles but at low power levels. Efficiency is approximately 55 percent (Figs. 6, 7).

Larger units of both the spark gap oscillator and vacuum tube oscillator are available but at high costs per kilowatt output and with space require-

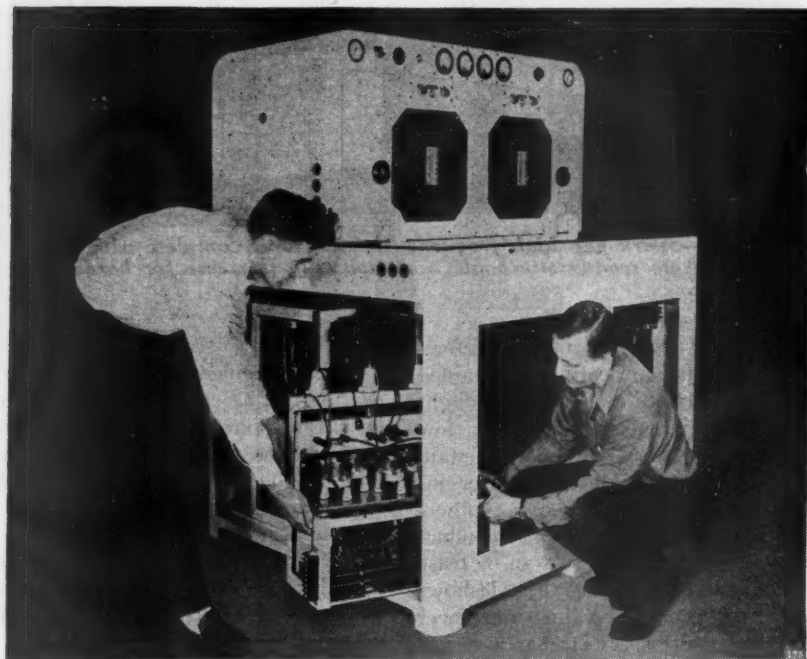


FIG. 6—Vacuum tube oscillator, 450,000 cycle induction heating unit. Note two work stations, each independently controlled and operated at different frequencies if required. Unit is made up of sub-assemblies as illustrated.

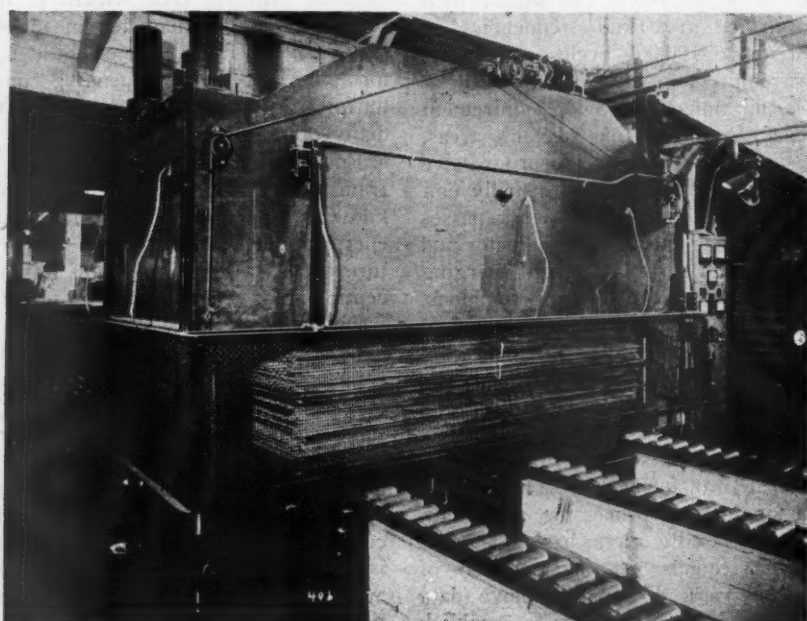
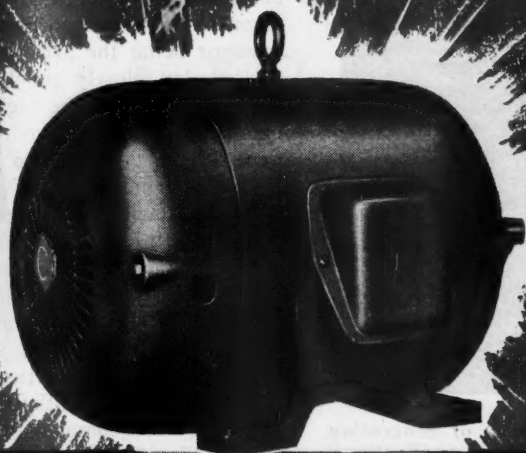


FIG. 7—Large dielectric heating installation for bonding of plywood. Only press with control panel at right is shown. Similar units are energized by 600 kw. Thermex Oscillators.

CENTURY Totally Enclosed Fan Cooled MOTORS

Provide
POSITIVE PROTECTION
Against



- ✓ Chips
- ✓ Metallic dusts
- ✓ Abrasive dusts
- ✓ Metal cuttings
- ✓ Coolant fog or mist
- ✓ Oil-laden dust
- ✓ Any non-explosive hazard



Longer motor life is assured when Century Totally Enclosed Fan Cooled Motors are used in destructive atmospheres. This is true for two major reasons:

1. The inner sealed frame of these motors prevents dusts, dirt, oils, mist, etc., from attacking motor insulation, windings, and bearings.
2. A large, enclosed fan provides effective cooling through large air passages. A controlled blast of cooling air carries heat away from active magnetic material and motor bearings.

Specify Century Totally Enclosed Fan Cooled Motors — be sure of protection that will keep your machines operating in any kind of destructive atmosphere.

Century Motors are available in a wide range of types and sizes from 1/20 to 600 horsepower.

Century 7½ horsepower Totally Enclosed Fan Cooled Motor furnishes power for an automatic lathe.



CENTURY ELECTRIC CO.
1806 Pine Street
St. Louis 3, Missouri

Offices and Stock Points in Principal Cities

CE 44

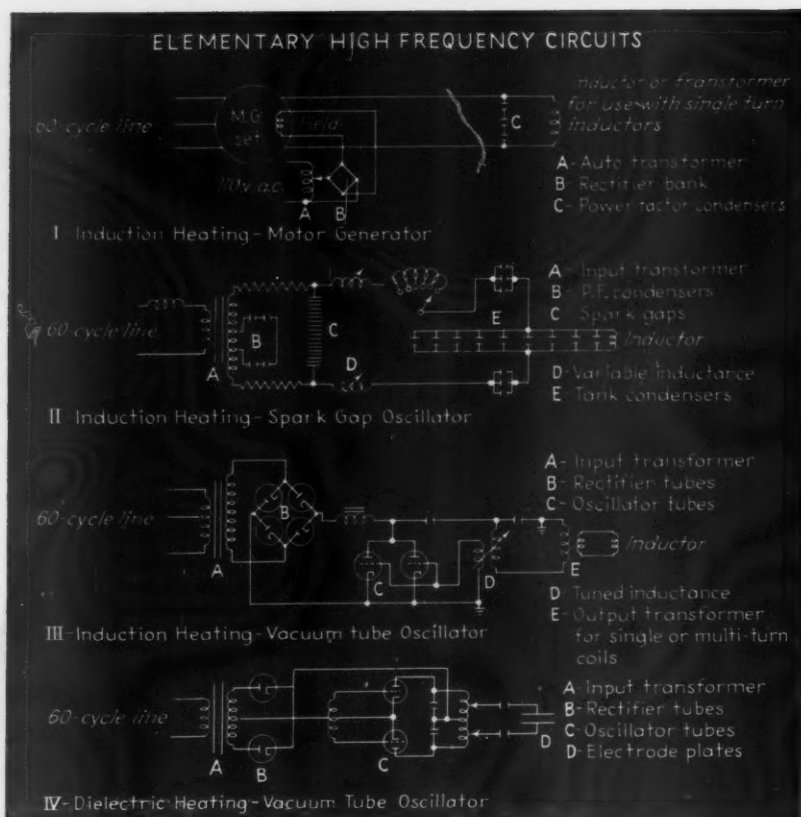


FIG. 8—Elementary Circuits of the three principal methods of generating high frequency energy for induction and dielectric heating applications.

ments so great in contrast to those of the rotating type that such equipment has not been considered commercially practical.

As the temperature of a bar increases, its electrical resistance does likewise and as a result the power absorbed falls off in a decrease in heating rate. With the spark gap set this problem theoretically could be overcome by continuous manual tuning of the internal inductance of the circuit to rematch the changing external inductance, but this naturally is not practical. The tube oscillators operate at resonant conditions which, while they change, do not do so as markedly. For short heating cycles of but a few seconds this decrease in power is not objectionable but for long cycles and particularly for deep heating the motor-generator units can be adjusted automatically to maintain reasonably constant power input. This is accomplished by automatic improvement of the power factor by cutting in additional capacitance or automatic leveling of the output voltage by means of a regulator.

Since the earlier observations of dielectric heating phenomena many explanations have been offered as to just why non-metallic material gets hot when correctly subjected to high frequency energy. No simple relationship has really been evolved between the variables, which include frequency

voltage, and electrical characteristics of the material, which will permit justification of dielectric heating as a type of hysteresis. It must be admitted, however, that a clearer general understanding of the mechanism of this method of heating will be on the basis of some molecular consideration. The changing polarity of the field created by the alternating current occurs at such a rapid rate that it is felt there is a certain mechanical distortion of the molecular structure which is subject to the pulsating stresses. *A combination of a natural reaction to severe distortion of the molecules and the attempt to readjust to their normal position requires a certain amount of work energy which is dissipated in the form of heat within the molecule. The rate at which this energy is dissipated is in proportion to the square of the field intensity. The shape of each molecule is actually changed with each reversal of polarity of high frequency field.*

Induction and Dielectric Compared

As explained in earlier portions of this article, induction heating of metals depends primarily on the quantity of current which is induced to flow through its cross section. *Thus the rate of heating is in direct proportion to the square of the current.* In dielectric or, as it is sometimes called, electrostatic heating, the rate of heat de-

veloped is related to the field intensity and depends upon the voltage, the frequency, as well as the capacity and power factor of the material. *The energy produced is proportional to the square of the voltage coupled with the others mentioned, but it is interesting to note that voltage is the controlling feature whereas with induction heating we are concerned primarily with current.*

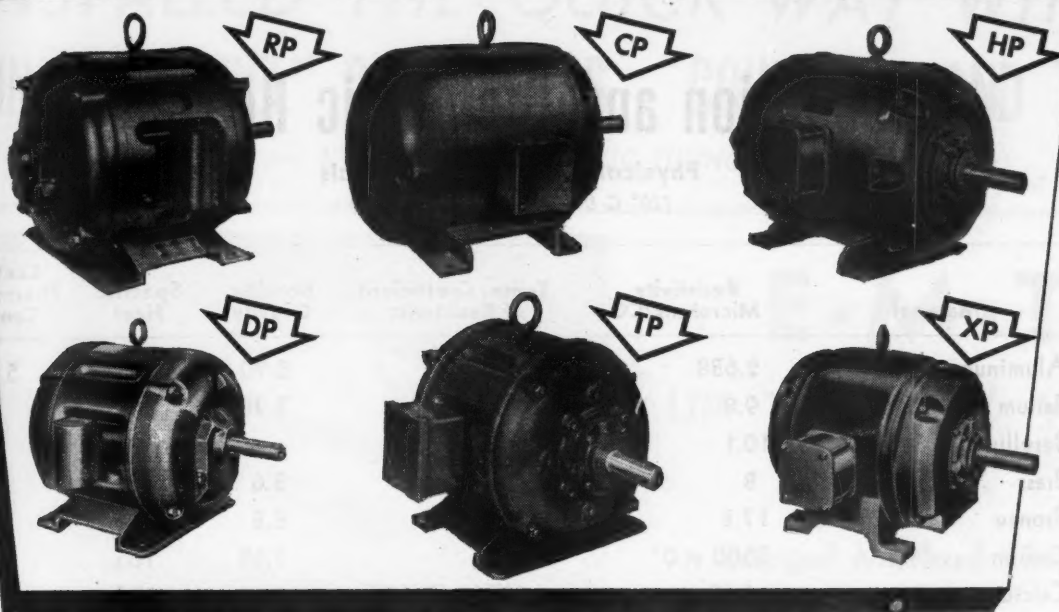
Regardless of whether the source of high frequency is obtained from a motor-generator, a spark gap oscillator, or a vacuum tube oscillator, the metal being inductively heated becomes the secondary of a transformer circuit, the inductor being the primary. It is insulated, but closely coupled with the inductor carrying the high frequency energy supplied by the oscillator or generator. There is no contact between the inductor and the charge. With dielectric heating, on the other hand, high frequency at high voltage is generated across plates or electrodes which are in direct contact with the non-metallic material being heated dielectrically.

In the case of induction heating of conductive materials, the high frequency energy is generated in the surface in accordance with details covered in previous portions of this article. *With dielectric heating, on the other hand, there is no skin effect and the heat is generated uniformly throughout the cross section of the mass when placed between equivalent areas of electrodes.*

Any material which is capable of conducting electricity can be efficiently heated by high frequency energy. The selection of frequency is in no way whatsoever dependent upon electrical characteristics of the material, and provided the dimensions of the material will respond to the frequencies employed, the same conversion of kilowatts to B.t.u.'s in the metal can be accomplished regardless of frequency. Obviously, the conversion factors will depend upon the electrical characteristics of the material since we are interested primarily in I²R losses.

The use of dielectric heating for non-metallics brings up the consideration of the dielectric characteristics of the material. Experience has shown, however, that dielectric materials generally processed do not exhibit need for critical frequencies. The frequency used requires the use of a voltage below arc-over values, but rather wide ranges of frequencies (all in the megacycle range) will show no particular advantage one way or another. While equipment is manufactured for operating at various selected frequencies, a fixed frequency unit can be used efficiently in most cases on a wide variety of materials.

Wagner offers a Complete Line of Motors for all Industrial Applications



Wagner motors (shown here in their electrical and mechanical variations) embody the latest developments in design. They are simple, rugged and dependable and have long life in addition to good electrical performance.

The tables below show the electrical and mechanical types of Wagner polyphase squirrel-cage and wound-rotor motors available for industrial applications.

ELECTRICAL TYPES OF WAGNER POLYPHASE MOTORS

Type	Rated	Electrical Characteristics	Applications
RP-1	1-10 to 400 hp 3- and 2-phase 25 to 60 cycles 110 to 2300 volts	Normal Torque— Normal Slip	Group or individual drives on machine tools, fans and blowers, compressors, centrifugal pumps—on any applications where normal-torque motors are satisfactory.
RP-5	1½ to 100 hp 3- and 2-phase 60 cycles 110 to 2300 volts	High Torque— Normal Slip	Crushers, plunger pumps, belt conveyors starting under load, large air compressors, large refrigerating machinery, mixers, and other applications requiring high starting-torque.
RP-6	½ to 150 hp 3- and 2-phase 25 to 60 cycles 110 to 2300 volts	High Torque— High Slip	Punch presses, shears, metal-drawing operations, balers and other machinery equipped with flywheels or having flywheel effect.
RP-7	1 to 50 hp 3- and 2-phase 25 to 60 cycles 110 to 550 volts	High Torque— High Slip	Elevators, cranes, hoists, dumb-waiters.
RS-1	1 to 250 hp 3- and 2-phase 25 to 60 cycles 110 to 550 volts	Continuous Duty— constant and adjustable varying speed	Conveyors, compressors, pulverizers, etc., requiring continuous operation.
RS-2	2 to 200 hp 3- and 2-phase 25 to 60 cycles 110 to 550 volts	Intermittent Service— Crane and hoist duty	Elevator, crane, hoist, and like services which operate intermittently.

MECHANICAL TYPES OF PROTECTED AND ENCLOSED SQUIRREL-CAGE MOTORS

Type	Rated	Mechanical Characteristics	Applications
CP	1½ to 125 hp 2- or 3-phase 25 to 60 cycles 110 to 2200 volts	Totally-Enclosed Fan-Cooled	Locations where dust, filings, fumes, moisture, and other abrasive and corrosive agencies shorten the life of open-type motors.
HP	¾ to 125 hp 2- or 3-phase 25 to 60 cycles 110 to 2200 volts	Explosion-Proof	For Class I Group D locations involving flammable volatile liquids, highly-flammable gases, and other highly-flammable substances.
TP	¼ to 15 hp 2- or 3-phase 25 to 60 cycles 220, 440, or 550 volts	Totally-Enclosed Nonventilated	(The equivalent of type CP, but in smaller ratings not needing external fan cooling.)
DP	¼ to 5 hp 2- or 3-phase 25 to 60 cycles 110 to 550 volts	Drip-proof	Locations involving dripping liquids and falling metal chips and other particles.
XP	¾ to 50 hp 2- or 3-phase 25 to 60 cycles 110 to 550 volts	Splashproof	For outdoor and indoor locations where motors are subjected to splashing liquids.

M45-21

OTHER WAGNER PRODUCTS



Write for Bulletin TU-180 on Wagner Transformers, and Bulletin IU-186 on Wagner Industrial Hydraulic Braking Systems.



Wagner

ELECTRIC CORPORATION
6413 Plymouth Avenue, St. Louis 14, Mo., U. S. A.
ELECTRICAL AND AUTOMOTIVE PRODUCTS

Send for
**BULLETIN
MU-185**

**FOR COMPLETE
MOTOR INFORMATION**



DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

Induction and Dielectric Heating

Physical Constants of Metals

(20° C Unless Otherwise Specified)

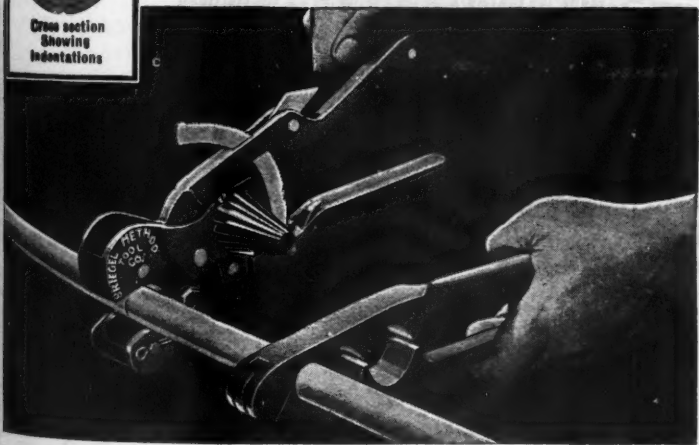
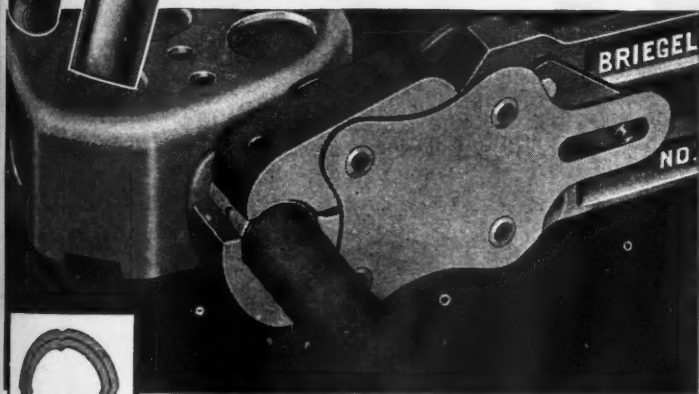
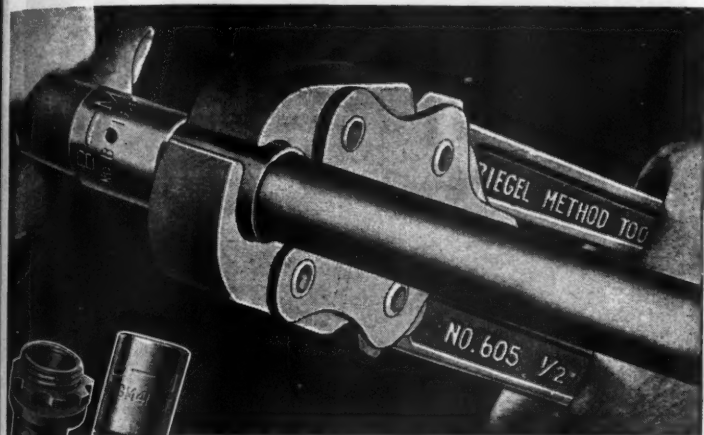
Material	Resistivity Microhms/CC	Temp. Coefficient of Resistance	Specific Gravity	Specific Heat	Coeff. Thermal Cond.
Aluminum.....	2.688	.00403	2.70	.214	.5
Barium.....	9.8	.0033	3.78	.068	
Beryllium.....	10.1			.397	
Brass.....	8	.002	8.6	.092	.204
Bronze.....	17.8	.0005	8.8	.086	
Carbon.....	3500 at 0°	.0009	3.52	.165	
Calcium.....	4.59	.00364 (0-600)	1.54	.157	
Chromium.....	2.6 at 0°		6.92	.11	
Cobalt.....	9.7	.00658 (0-100)	8.71	.10	
Copper.....	1.724	.00393	8.89	.0921	.918
Gold.....	2.44	.0034	19.3	.0312	.7
Graphite.....	800 at 0		2.25	.17	
Iron.....	9.8	.0065 (0-100)	7.8	.107	.161
Iron Cast.....	79-104		7.03	.118	
Lead.....	22.0	.0039	11.4	.0306	.083
Magnesium.....	4.46	.004	1.74	.246	.376
Manganese.....	5		7.42	.121	
Mercury.....	95.8	.00089	13.59	.033	.015
Molybdenum.....	5.08 at 0	.0047 (0-100)	9.0	.065	.346
Monel Metal.....	42	.002	8.9		.062
Nickel.....	7.8	.00537 (20-100)	8.9	.105	.142
Platinum.....	9.83 at 0	.003	21.4	.0324	.166
Potassium.....	6.1 at 0	.0055 at 0	.851	.19	
Silver.....	1.629 at 18	.0038	10.5	.056	1.0
Sodium.....	4.3 at 0	.0054	.951	.295	
Steel (Soft).....	11.8	.004	7.7	.118	.115
Steel (Hard).....	45.6	.0016	7.7	.118	.115
Steel (Nickel).....	30-85	.0007	7.7	.118	.115
Tantalum.....	15.5	.0031	16.6	.036	.130
Thallium.....	17.6 at 0	.0040 at 0	11.86	.038	
Thorium.....	18	.0021 (20-1800)	11.5	.027	
Tin.....	11.5	.0042	7.3	.054	.155
Tungsten.....	5.5	.0047 (0-100)	19	.034	.476
Zinc.....	5.75 at 0	.0037	7.1	.093	.265

Note: Data compiled by the Industrial Electronics, Division, Westinghouse Electric Corporation, Baltimore, Md.

E·M·T

INSTALLED THE QUICK WAY WITH ORIGINAL "BRIEGEL" CONNECTORS · COUPLINGS AND TOOLS

FOR 1/2", 3/4", and 1" ELECTRICAL METALLIC TUBING (Thin Wall Conduit)



E·M·T

UP THE *Quick* WAY

WITH

Briegel Method Fittings

(All B-M Fittings carry the Underwriters Seal of Approval.)

TWO QUICK SQUEEZES give you finer, Faster Conduit Connections. B-M Fittings do away with the twisting, turning and tightening of nuts and save you valuable time and materials. Then, too, they are stronger, neater, and much easier to work with in tight places. Start using B-M fittings today. Have more satisfied customers—more profits from each job!

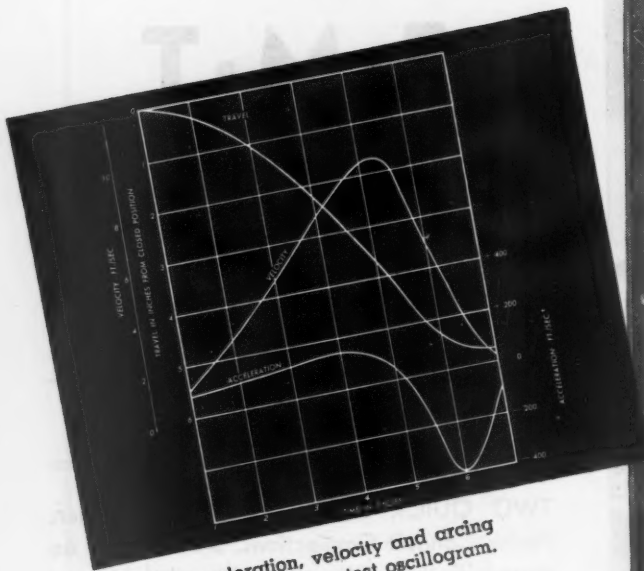
Automatic Feed Tube Cutter

Cut 1/2", 3/4" and 1" E. M. T. the quick, easy way! Only one Setting. Just clamp the Briegel No. 100 Tube Cutter on the E. M. T. and give it a few turns. No further adjustments necessary. Constant Spring Tension does the rest—gives you a clean cut from the original setting—does away with the tube distortion and gives longer cutter life. A Handy Reamer is attached to its side. A couple of twists removes any slight inside burr.

Also shown is the Briegel Tube Holder that accommodates all sizes of E. M. T. from 1/2" to 1" without damage to outer coatings.

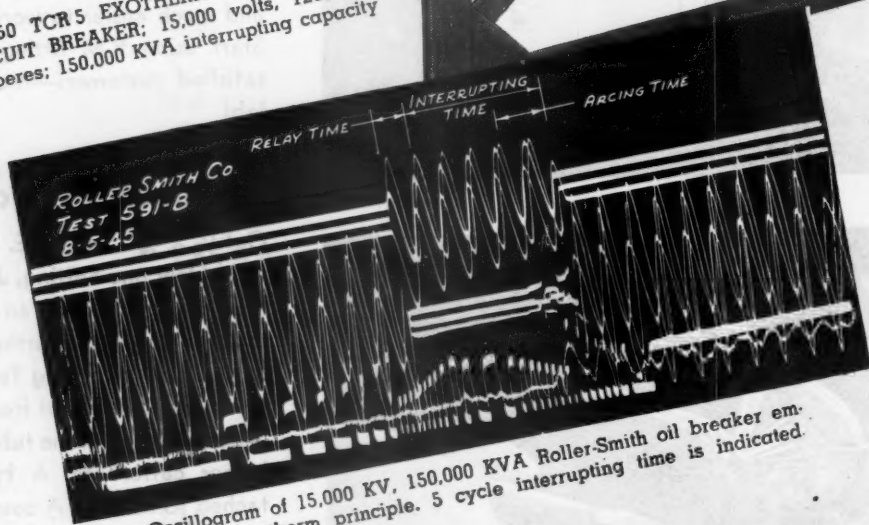
BRIEGEL METHOD TOOL COMPANY
GALVA, ILLINOIS

New



Curves of acceleration, velocity and arcing time derived from breaker test oscillogram.

150 TCR 5 EXOTHERM TYPE OIL CIRCUIT BREAKER; 15,000 volts, 1200 amperes; 150,000 KVA interrupting capacity



Oscillogram of 15,000 KV, 150,000 KVA Roller-Smith oil breaker employing Exotherm principle. 5 cycle interrupting time is indicated.

ROLLERS



ROLLER-SMITH BREAKER

Gives 5 Cycle Opening with newly discovered *EXOTHERM* principle of Arc Extinction - - -

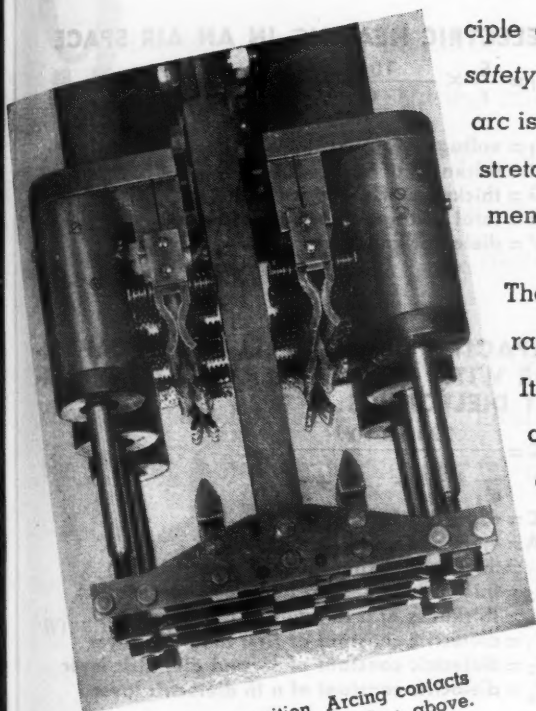
THE new Roller-Smith oil circuit breakers with the Exotherm principle of arc extinction give 5 cycle opening consistently, a 38% safety factor over present accepted standards. That's because the arc is put out by use of its gas-generated energy instead of merely stretching the arc. Users are assured greater protection to equipment by this higher opening speed.

The operation of a confining chamber to quench the arc rapidly is based on the known properties of gas conductivity. It decreases with decrease in gas temperature and also decreases with an increase in pressure. In the quencher the cooling of the arc extracts its energy and reduces the temperature. At the same time the enclosure builds up the gas pressure so that it becomes less conducting and the combination puts out the arc.

The greater speed on opening cuts down contact burning and thereby reduces contact maintenance. It also gives improved protection to equipment against short circuits because of the higher speed of opening.

Confining the gas within the quenching chamber to put out the arc keeps the pressure within the tank at a safe nominal value.

For full information on the Exotherm principle applied to Roller-Smith oil circuit breakers, write to dept. EC-5



Breaker in open position Arcing contacts shown with quenching chamber above.



SMITH

Oil Circuit Breakers

BETHLEHEM • PENNSYLVANIA

In Canada: Roller-Smith Marsland, Ltd., Kitchener, Ontario

STANDARD AND PRECISION ELECTRICAL INSTRUMENTS • AIRCRAFT INSTRUMENTS • SWITCHGEAR
AIR AND OIL CIRCUIT BREAKERS • ROTARY SWITCHES • RELAYS • PRECISION BALANCES

DATA SHEET

The number at the right is a classification for convenience in filing and for a future data sheet index

H-2

Induction and Dielectric Heating

Dielectric Heating Formulas

1. CAPACITY OF A PARALLEL PLATE CAPACITOR

$$C = .224 \frac{e' A}{D} \times 10^{-12} \text{ (farads)}$$

C = capacity (farads)

e' = dielectric constant

A = electrode area (sq. in.)

D = distance between electrode (in.)

2. POWER INPUT INTO A DIELECTRIC

$$P_v = 1.41 f E^2 e'' \text{ (watts/cu. in.)}$$

P_v = power density

f = frequency (Mc/ sec.)

E_i = kilovolts/in

e'' = loss factor

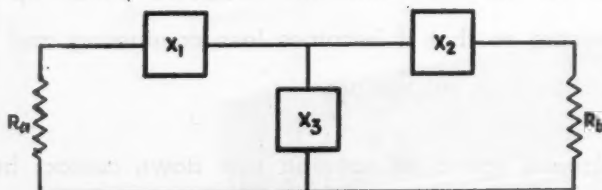
3. "T" NETWORK EQUATIONS

$$\frac{R_a}{R_b} = \frac{X_1 + X_3}{X_2 + X_3} - R_a R_b$$

$$= X_1 X_2 + X_1 X_3 + X_2 X_3$$

R = resistance (ohms)

X = reactance (ohms)



4. EFFECTIVE SERIES RESISTANCE OF A CAPACITOR

$$R = X \text{ (PF) ohms}$$

$$X = \frac{1}{WC} \text{ ohms}$$

$$W = 2 \pi f$$

C = capacity (farads)

PF = power factor

5. DIELECTRIC LOSS FACTOR

$$e'' = (\text{PF}) \times e' = \text{loss factor}$$

PF = power factor

e' = dielectric constant

6. WAVE LENGTH ALONG ELECTRODES

$$\lambda = \frac{984}{f e'} \text{ (ft.)} = \text{wave length (ft.)}$$

$$f = \text{frequency Mc/sec}$$

$$e' = \text{dielectric constant}$$

7. DIELECTRIC HEATING IN AN AIR SPACE

$$E_i = \frac{E}{t} \times \frac{10^{-3}}{1 + \frac{G}{t} e'}$$

E_i = voltage gradient (kv/in.)

t = thickness of work

G = thickness of air space

E = total voltage across plates (volts)

e' = dielectric constant

8. CAPACITY OF PARALLEL PLATE CAPACITOR WITH PARALLEL LAYERS OF DIFFERENT DIELECTRICS

$$C = \frac{.224A \times 10^{-12}}{\frac{a_1}{e'_1} + \frac{a_2}{e'_2} + \dots + \frac{a_n}{e'_n}}$$

C = capacity (farads)

A = electrode area (sq. in.)

a₁ = thickness of first layer of dielectric (in.)

a₂ = thickness of second layer of dielectric (in.)

a_n = thickness of n th layer of dielectric (in.)

e'₁ = dielectric constant of first dielectric layer

e'₂ = dielectric constant of second dielectric layer

e'_n = dielectric constant of n th dielectric layer

9. VOLTAGE GRADIENT IN ANY DIELECTRIC LAYER IN PARALLEL PLATE CAPACITOR WITH PARALLEL LAYERS OF DIFFERENT DIELECTRICS

$$E_i = \frac{E \times 10^{-3}}{e'_k \frac{a_1}{e'_1} + \frac{a_2}{e'_2} + \dots + \frac{a_n}{e'_n}} \text{ Kv/in.}$$

E_i = voltage gradient (Kv/in.) of layer considered

E = total electrode voltage (volts)

e'_k = dielectric constant of dielectric layer considered

a₁ = thickness of first dielectric layer (in.)

a₂ = thickness of second dielectric layer (in.)

a_n = thickness of n th dielectric layer (in.)

e'₁ = dielectric constant of first dielectric layer

e'₂ = dielectric constant of second dielectric layer

e'_n = dielectric constant of n th dielectric layer

Data compiled by the Industrial Electronics Division, Westinghouse Electric Corporation, Baltimore, Maryland.

What percentage of your SALES is "Repeat Business?"

Generally, "repeat business" is built upon previous satisfactory relationships between your customer and yourself. If you do a good job the first time, chances are you'll get another chance when any further business in your line comes up. But, you can not do a satisfactory job unless you use materials that were designed for the job at hand.

All Simplex insulated wires and cables from the small Type SJ TIREX cords to the heaviest paper insulated Power cables are designed specifically for the job at which you intend to use them.

Simplex quality and workmanship are well known wherever insulated wires and cables are used.

The next time you have need for wire and cable of any type, call in the Simplex sales representative first. Then you'll get the wire you want, made to meet the conditions of the job at hand and at a price that's reasonable and fair.

Simplex Wire & Cable Co., 79 Sidney Street, Cambridge 39, Mass.



Simplex

WIRES and CABLES

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repair. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published, we pay \$5.00.

READER'S QUIZ

GROUNDING IN OLD FACTORY BUILDING

QUESTION 196—*What would be the best method of grounding in an old factory building where the basement floor is cement with no structural iron available except the $\frac{1}{2}$ inch iron rods in the floor. There are a few small water lines but not very handy. Would grounding on these water lines be dangerous to anyone repairing them if the pipe line had to be disconnected? Is grounding to the sprinkler system permissible? Our equipment is 480 volts with around 150 motors running up to individual ratings of 50 hp.—W.L.C.*

A. TO QUESTION 196—The half-inch iron rods in the floor (presumably reinforcing) could not be considered grounding electrodes. The soil under the floor probably is quite dry and would have a high resistance.

A water pipe no longer is a ground if it is disconnected between a grounding connection and the point where the pipe enters the ground. Severe shocks have been received by pipe fitters when disconnecting a pipe under these conditions. A good rule to observe is "Always place a suitable jumper around the place a water pipe ground is being disconnected." Of course, this rule is unnecessary if the ground connection lies somewhere between the street and the pipe work being done.

Grounding to the sprinkling system is not specifically covered in the Code. Cold water pipes, grounded building frames, underground gas pipes, well casings, local underground water pipes and artificial grounds are approved under certain conditions. A sprinkler system is not always filled with water. The air in the pipes holds back the water until pressure is released by opening sprinkler head. Good electrical connection is therefore not assured.

The solution, under the conditions given, would be to run a ground bus. This could be run around the building

walls or down through the center as most convenient. Ground connection should be made to one of the water pipes, as near its building entrance as possible. If not subject to severe mechanical injury, the ground bus need not be protected. Also it may be supported directly on the building without the use of insulators. The size is determined by mechanical strength and the maximum current the ground bus would ever have to carry. Equipment grounds can be connected to the ground bus as convenient.—L.E.B.

A. TO QUESTION 196—In considering the best method of grounding in the old factory building, with a cement basement floor and no structural iron available except the reinforcing rods, we must consider the fundamental reasons for grounding. Circuits and equipment are grounded to minimize voltage to ground which might otherwise occur, in order to reduce insulation failures, fire hazards and shock hazards. We wish to limit dangerous voltages due to lightning, primary voltages and secondary voltages.

Where the equipment is supplied from a 480 volt 3 phase source, it seems probable there is no ground connection on any of the conductors of the circuit. The only grounding which is contemplated then is the grounding of the noncurrent carrying metal parts of equipment. The purpose of grounding is primarily to limit the voltage to ground and the voltage between noncurrent carrying metal parts of equipment and surrounding metallic equipment and surfaces of other than insulating materials.

It must be recognized that even very good ground connections having low resistance and high current carrying capacities, probably will not result in clearing the circuit by operating the overcurrent protective device unless there is a second accidental ground on another phase of the circuit. If there is no such second ground and the fault which does exist, connects one of the phase wires directly to the noncurrent

carrying metal parts of equipment, the current which flows to ground will depend upon the voltage, the resistance at the point of breakdown in the insulation, the resistance of the ground connection or connections and the insulation resistance and the capacitance existing between the ground and the other ungrounded conductors. The result will probably be a relatively small current, but the difference in potential between different parts of equipment will depend upon the drop through the resistance, reactance and capacitance. It is desirable to have all normally noncurrent carrying conductive parts (metal) well bonded together so that there will not be any appreciable difference of potential existing between two parts which may be contacted by a person at the same time. For instance, having a machine frame become alive due to breakdown in insulation will expose the operator to serious danger if there is a grounded surface such as a water pipe, sprinkler pipe or other conducting material near.

Regarding the definite problem, while grounding to small water pipes is not particularly desirable, if these are the only lines available, it would be proper to ground to them. If the ground connection is made to the pipes inside the building, a person disconnecting the piping between this point and the ground might receive a shock should there be a fault current flowing. Such grounding connections should be made as near as possible to the entrance of the water pipe to the building, and any meters, unions, etc., should be jumped or bonds should be connected around them. It would also be desirable to ground to the sprinkler system near the point where it comes out of the ground or into the building. It would not be desirable to ground to it at any great distance from its connection to underground piping, since this system may also be interrupted. The sprinkler system and the water system should be bonded together.—J.E.W.

A. TO QUESTION 196—Underneath that concrete basement

YOU NEED THESE ITEMS FOR QUALITY SERVICE



MACALLEN MICA

... It Has What It Takes!

MACALLEN MICA is the universal choice in every shop doing quality, guaranteed motor service work. **MACALLEN MICA** has the highest dielectric strength of all easily worked insulation materials and is unaffected by heat.

Manufactured under exacting production controls to insure perfect accuracy, **MACALLEN MICA** is furnished in sheets in all thicknesses and sizes for moulding and cold forming, segments, and in every other form required for all shop needs.

Use **MACALLEN MICA** for your best jobs.

Samples and Prices Sent on Request



MANNING INSULATING PAPERS

... They're TOUGH!

MANNING No. 300 tops the field of insulating papers. 100% rag content—excellent dielectric strength—maximum varnish absorption—superior heat aging quality—won't delaminate—tough to tear—saves labor on rewinds—protects against shorts or grounds—**MANNING 300 PAPERS** offer the best on every count.

Uniform in thickness—furnished in all convenient sheet sizes and weights.

Avoid comebacks—insure your work and profit with **MANNING INSULATING PAPERS**.

Write for Samples and Prices



KIRKWOOD COMMUTATORS

... Built For Long Service!

KIRKWOOD dependable **COMMUTATORS** insure against service failures. Engineered for accuracy—precision machined to bore and diameter—bars that won't throw—high grade mica—heat treated to reduce expansion and excess mica binder—**KIRKWOOD COMMUTATORS** will withstand the most severe changes of vibration, heat and speed.

Engineering skill and the finest production methods guarantee **KIRKWOOD** built-in quality.

Prompt shipment from stock can be made on commutators for refrigeration, commercial or vacuum cleaner motors, and automotive types.

Ask for Complete Kirkwood Catalog



INSULATION AND WIRES INCORPORATED

2127 PINE ST. • ST. LOUIS 3, MISSOURI

BOSTON 20, MASS.
HOUSTON 2, TEX.

DETROIT 2, MICH.
BLUEFIELD, W. VA.

ATLANTA 3, GA.
NEW YORK 7, N. Y.

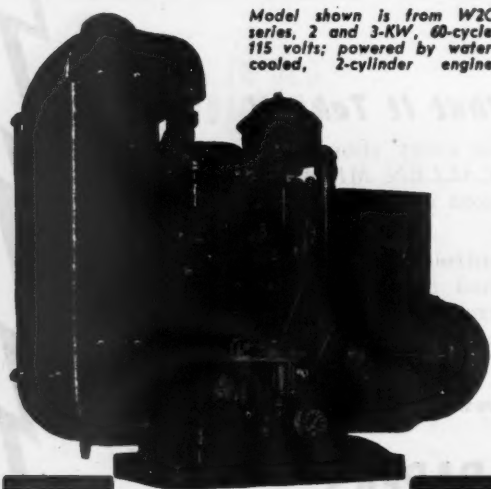
Send
for Your Copy
of the IWI
Blue Catalog.

ELECTRICITY

For Any Job—Anywhere

Reliable, economical electric service for electrical contracting projects anywhere, anytime, with an Onan Electric Generating Plant. From the 65 basic models, the right plant for any job or application, large or small, can be selected.

Driven by Onan built, 4-cycle gasoline engines, these power plants are of single-unit, compact design and sturdy construction. Suitable for all mobile, stationary or emergency service.



Model shown is from W2C series, 2 and 3-KW, 60-cycle, 115 volts; powered by water-cooled, 2-cylinder engine.



Models range from 350 to 35,000 watts. A. C. types from 115 to 660 volts; 50, 60, 180 cycles, single or 3-phase; 400, 500, and 800 cycle, single phase; also special frequencies. D. C. types range from 6 to 4000 volts. Dual voltage types, available. Write for engineering assistance or detailed literature.

Over 250,000
In Service

D. W. ONAN & SONS

2110 ROYALSTON AVE.
MINNEAPOLIS 5, MINN.

Check these Characteristics
OF SUPERIOR SILVER BRUSHES

AGAINST YOUR
NEEDS

CHARACTERISTICS OF SUPERIOR SILVER GRAPHITE BRUSHES

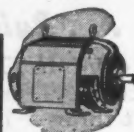
Grade No.	Percentage of Silver	Specific Resistance per Inch Cube	Hardness	
B-54	20%	.00045	25-30	Artificial graphite base
C-45	50%	.00015	20-25	Artificial graphite base
D-10	50%	.0001	20-25	Graphitized base stock
D-11	20%	.0004	20-25	Graphitized base stock
E-65	10%	.0008	25-30	Artificial graphite base
E-72	60%	.00003	15-20	Artificial graphite base
E-60	15%	.00065	15-20	Natural graphite base
E-82	15%	.001	65-70	Lamp black graphite base

If you don't see exactly what you want here, our Research Department will be glad to work out the one right answer for you.

SUPERIOR CARBON PRODUCTS, INC.
9113 GEORGE AVENUE CLEVELAND 5, OHIO



SUPERIOR CARBON BRUSHES



floor, there are the makings of the best possible ground for your purpose because the earth will contain the same amount of moisture all through the year.

Drill a two inch hole through the concrete, using the largest type ground rod available. Check for low resistance. If not under five ohms, obtain lengths of rigid conduit that will drive down over the ground rod and force down lower. It is possible that you may need to go down 20 feet.

I would not use the small water pipe lines which you say are inconvenient. Since a good ground is a valuable asset to any type of electrical distribution, it should be a permanent installation, and not subject to a break as you say your water pipes may be in case of repair or changes.

The sprinkler system is out of the question.

When you have established a permanent ground, your conduit system will provide all the protection necessary.—W.H.L.

A. TO QUESTION 196—I think the best method of grounding in an old factory building would be to use a bus duct system for power distribution with conduit or cable drops from plug-in switches to the machine tools. A cable is made with 3 conductor and ground wire, all sizes.

In our plant we use bus duct with conduit or cable drops (depending on the condition), in this manner every machine is grounded to the bus duct and the bus duct is grounded to the substation tower. This is a very efficient way of grounding and is much safer than connecting to water lines.—R.D.R.

RESISTANCE SHORTS

QUESTION 197—After removing a 500 kw. d-c generator armature, we encountered difficulty in checking for a short-circuited coil or coils. The armature is wound progressive, simplex, four-element coil (using strap copper) lap winding with equalizers connected to every fourth commutator segment.

What is a convenient method for checking such large armature coils for shorts?—E.J.K.

A. TO QUESTION 197—A coil of 1000 turns of wire on $\frac{1}{2}$ inch \times $\frac{1}{2}$ inch \times 6 inches straight laminations placed in the X side of an ac bridge, with the end of the laminations touching the same place, one side of a growler touches, will indicate low re-

f the best
pose be-
the same
ough the
ough the
e ground
istance.
n lengths
ve down
ce down
may need
ater pipe
nvenient.
ble asset
tribution,
tallation,
you say
case of
t of the
d a per-
system
n neces-
-I think
nding in
d be to
wer dis-
le drops
machine
3 cones.
uct with
ding on
er every
ous duct
l to the
ery effi-
is much
lines-

distance shorts by having one resistance for a shorted coil and another resistance for a normal coil.
For high resistance shorts, you will need a higher frequency for example, 4000 cycles or a higher current across the choke coil.—H.S.

REWINDING STATORS

QUESTION 198—We have several $\frac{3}{4}$ hp. single phase repulsion induction motors which have special built frames and operate vacuum pumps. We would like to convert these motors to three phase operation. The armature shafts are longer than standard motors and carry the pump impellers. Replacement of these is out of the question. Therefore, we would like to rewind the stators for three phase and simply short circuit the entire commutator for the job. Would these motors operate efficiently connected in this manner?

ANSWER TO QUESTION 198—You can operate your present $\frac{3}{4}$ hp. repulsion start motors satisfactorily on 3-phase if the armature windings are shorted and if a proper 3-phase winding is placed in the stator.

There are certain things about common single phase design that are likely to give you a headache or two if not properly guarded against. The fact that you may find a wide tooth in the middle of the original pole can be disregarded, and the winding should be distributed in the slots as they are found.

The worst thing that can happen is to get a perfectly good three-phase field and find that the motor will not start. This is due to the fact that the number of armature slots is divisible by the number of poles. Cutting out a coil will not help. In an emergency we once drove the armature teeth around so that at the air gap we had one less than the original number of tooth tips. In doing this, we increased the air gap and ruined the efficiency of the motor, but it ran satisfactorily for years.

In two other cases we made new armatures by squaring some sheet iron, assembling between boards, boring center hole, assembling on shaft, and turning to size and milling 31 slots. A $\frac{1}{4}$ -inch by $\frac{1}{2}$ -inch copper bar brazed to a $\frac{1}{8}$ -inch by $\frac{1}{2}$ -inch cross section end ring makes a good winding for almost any fractional rotor.

The easiest solution of this problem and the one which we are now using, regardless of the number of slots, is to

How to IMPROVE MOTOR PERFORMANCE

Catalogue

76 Pages of
Bearing Informa-
tion. Write for
free copy.

● How many *lazy* motors in your shop? Before you blame the motor . . . take a look at the bearings. Are they the right type . . . the correct fit . . . are they in line . . . do they need replaced? When you install Johnson Electric Motor Bearings you can forget about bearing trouble. Every Johnson Bearing is cast in the correct alloy for long life and superior performance. They are correct in design and tolerance . . . easy to install. When you buy Johnson you buy the best.

JOHNSON BRONZE COMPANY
490 S. Mill St. New Castle, Pa.





You Bet, TRICO

RENEWABLE FUSES

ARE
POWDER-PACKED



As shown, the renewal element (the heart of any fuse) is different! It's custom-built! The fusible link is enclosed for full protection. No twisting, bending, kinking or fractures to reduce carrying capacity before the link is actually inserted in the fuse casing.

The powder-packing supports the link and prevents sagging stretching or thinning out which always causes premature blowings and unnecessary shutdowns.

Only genuine TRICO elements of the correct size can be inserted in TRICO FUSES. This non-interchangeable feature guarantees top-notch efficiency—no tampering—no "doubling-up" of links to damage instead of protecting expensive equipment.

For maximum protection and three times the service **INSTALL TRICO RENEWABLE FUSES.**

Write for Bulletin #1

TRICO FUSE MFG. CO.
MILWAUKEE 12, WISCONSIN

- TAMPER-PROOF
- NON-INTER-CHANGEABLE LINKS
- SAFE TIME LAG
- LINK SUPPORT
- LIFE-TIME OUTER PARTS
- GUARANTEED RESULTS
- COST NO MORE

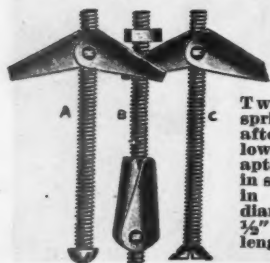


Foolproof Fastenings

FOR HOLLOW WALLS PAINE TOGGLE BOLTS

Strongest, safest method of fastening equipment in hollow material. Easily and quickly installed, Paine Toggle Bolts will not pull out or work loose. All types supplied with standard machine screw thread.

SPRING WING TYPE

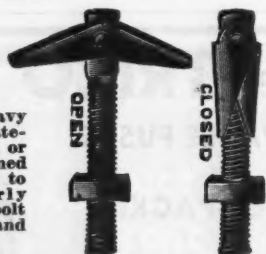


123

Two-piece toggle springs into place after insertion. Allows wide-range adaptability. Available in several head styles in standard bolt diams. from $\frac{1}{4}$ " to $\frac{1}{2}$ " in standard lengths.

125

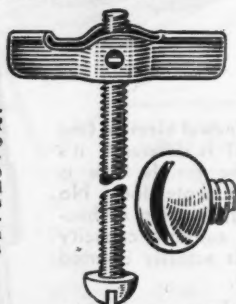
Designed for heavy duty in such materials as tile, steel or metal lath. Flattened bolt end riveted to toggle. Regularly supplied in 2 bolt sizes only— $\frac{5}{16}$ " and $\frac{3}{8}$ " diam.



ONE-PIECE TYPE

150

This type offers exclusive feature of equal holding surface on both sides of toggle. One-piece toggle is riveted to flattened bolt end and pivots into position after insertion. Available in same styles and sizes as No. 123.



PAINE TOGGLE BOLT CLAMP

Free with Every Box of Paine Toggle Bolts
Cuts installation time in half and protects the fingers.

Ask your Supplier or write for Catalog

THE PAINE CO.

2961 Carroll Ave. Chicago 12, Ill.
Offices in Principal Cities

PAINE
FASTENING
and HANGING DEVICES

short the armature by banding the commutator with bare copper wire and soldering, and using a T-connected winding in the stator. This is by far the easiest winding to figure and always has good starting torque. The only drawbacks are unbalanced currents and somewhat higher temperature than a properly distributed 3-phase winding. The former is of no great consequence in a fractional horsepower motor, and the latter is always less than the same motor running single phase at the same horsepower.

The winding consists of two elements; one, a duplicate of the original single phase winding as to turns with the center point brought out; the other element is about 71 percent of the turns of the other winding and placed 90 electrical degrees from it, as in a split phase winding. One end of this second winding is connected to the center point of the first element.

The power of this motor would be about 1.41 times its original rating. If this power is not needed and a cooler motor is desired, it can be cut down by giving it more turns. The horsepower is in inverse proportion to the square of the number of turns.

If the wide center tooth, mentioned above, is encountered, allowance will have to be made for the shorter span figuring the chord factor as though there were slots all the way around.

Theoretically, the second element of the winding should be 86 percent of the first, but experience has led us to adopt 71 percent.—A.S.T.

A. TO QUESTION 198—It is perfectly feasible to rewind the stator of a repulsion induction motor for three-phase operation, and to short-circuit the commutator of the rotor, so that the motor will operate as "squirrel cage" motor. Due to the relatively high resistance of the rotor winding as compared with a genuine squirrel-cage motor, the motor will have a rather drooping speed-torque characteristic, but to compensate for this disadvantage, the starting torque will be comparatively high. Since the airgap for repulsion motors is made as short as possible, the power factor will be comparable to other 3-phase induction motors. The rating of the converted motor should theoretically be 60 percent higher than the single-phase rating, but this increase in rating can probably not be fully realized because the available stator winding slots will not permit a "perfect" three phase stator winding.—S.V.H.

A. TO QUESTION 198—In redesigning a single-phase motor for operation on three-phase supply, the flux density in the core and therefore the voltage per turn must be kept

constant. The average effectiveness of the single-phase winding is determined by calculating its chord factor with which is combined the effect of the distribution factor. In the three-phase winding, the chord factor is determined in the same way as for a single-phase winding except that it must be multiplied with the distribution factor which is always equal to 0.955.

Inasmuch as the speed, frequency, and voltage are to remain the same in this case, the new winding may be calculated by the following step-by-step method:

1) *Available horse-power on three phase*—The horse-power rating of the single-phase motor rewound for three-phase will increase to approximately 150 percent.

2) *Calculation of single-phase distribution factor*—The distribution factor is the ratio of the sum of the effectiveness of each coil to the sum of the effectiveness of coils having full pitch. The sine of half the electrical angle spanned by each coil multiplied by the respective number of turns gives the effectiveness of that coil. For example, let us assume a single-phase motor having 24 slots wound with two poles. The number of slots per pole is 24 slots / 2 poles = 12, which corresponds to full pitch or 180 electrical degrees. The equivalent of one slot is 180 / 12 = 15 electrical degrees. The electrical angle spanned by a coil in slots 1 and 12 or with a pitch of 11 slots is 11 slots times 15 electrical degrees = 165 electrical degrees. Half this angle is 82.5. The sine of 82.5 degrees is equal to 0.991. The number of effective turns in this coil is 0.991 times N, where N is the actual number of turns in the coil.

3) *Calculation of three-phase chord factor*—In the three-phase connection, there will be 24 slots / 3 phase = 8 slots per phase. The number of slots per pole per phase is 8 slots per phase / 2 poles or 4. Using a two-layer, series connected, distributed standard diamond coil winding, there will be 8 coils per phase. Full pitch coil span will be 24 slots / 2 poles = 12 slots. This pitch results in unity chord factor with sides located in slots 1 and 13. As a result of mechanical difficulties met in accommodating the coil ends, however, let us assume that it becomes necessary to chord the winding to slots 1 and 11 or 10 slots. This fractional pitch reduces the chord factor from unity to sine ($\frac{1}{2}$ times 10/12 times 180) = 0.966. To compensate for this loss of winding effectiveness, the number of turns in series per phase must be increased in the proportion of 1 / 0.966 or 3.5 percent.

4) *Calculation of three-phase number of turns*—The number of turns in

series per phase for a delta connected winding will be:

$$T_s = T_1 \times \frac{K_1}{0.955 \times K_2}$$

where T_1 is the actual number of total single-phase turns.

K_1 is the calculated single-phase distribution factor.

K_2 is the calculated three-phase chord factor.

0.955 is the three-phase distribution factor which is constant.

The number of turns in series per phase for a star connected winding will be $T_s / 1.73$.

5) Calculation of magnet wire size—The size of magnet wire to use for series star connection is:

$$Q_1 = 1.5 / 1.73 \times T_1 / T_s \times Q_2$$

$$= 0.866 \times T_1 / T_s \times Q_2$$

If a delta connected winding is to be used:

$$Q_1 = 1.5 / 3 \times T_1 / T_s \times Q_2$$

$$= 0.5 \times T_1 / T_s \times Q_2$$

where Q is the cross-section of the wire in circular mils at the given number of phases.

6) *Modifying the rotor*—The wound rotor of the repulsion-start induction run motor may be converted into a squirrel cage by winding several turns of bare copper wire around the commutator which is then soldered to it.—R.G.C.

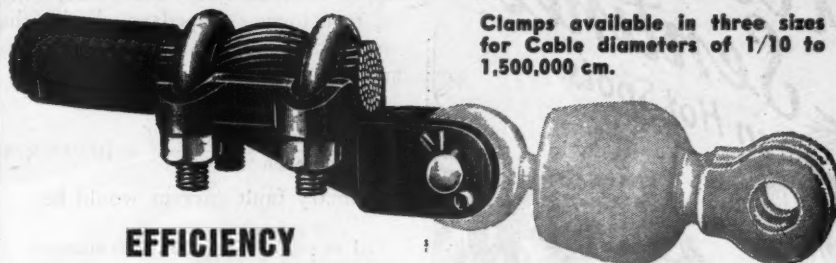
COMPUTING INTERRUPTING CAPACITY OF FUSES

QUESTION 199—We wish to make a temporary installation of some primary expulsion cutouts on a 4160 volt system which is fed from two banks of 40,000 kva each in parallel connected delta wye. The impedance of the transformers is 5 percent and their ratio is 11,000 to 4160 volts. What we want to know is what is the formula for determining the RMS value or the rating in kva, which the main fused disconnects will have to be capable of rupturing under fault conditions?

We are considering using 15 dropout type cutouts behind the main switch on the five individual sub feeds. However, we fear they may be completely shattered under fault and therefore constitute a hazard.—G.S.E.

ANSWER TO QUESTION 199—Since it was not stated what available short circuit capacity would be

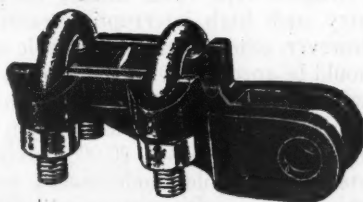
"EFFICIENCY" DEVICES FOR CONDUIT AND CABLE SUSPENSION



Clamps available in three sizes for Cable diameters of 1/10 to 1,500,000 cm.

EFFICIENCY CABLE STRAIN-CLAMP

... Stands Direct Pull of over 17,000 lbs. before cable slips!



By actual test, the EFFICIENCY Cable Strain Clamp will withstand a direct pull of over 17,000 pounds without permitting the cable to slip. This powerful grip results from the EFFICIENCY Clamp's "H" design, incorporating a high ridge across the center of the cable channel and a U-bolt at each end.

Adaptability to all requirements is provided in the EFFICIENCY Clamp's alternate construction . . . which may be clevis or eye, according to your requirements. Both styles are furnished for A.C. or D.C. service.

Write today for your copy of EFFICIENCY Catalog No. 38A . . . contains complete construction and application data on all EFFICIENCY Devices.

Efficiency
ELECTRIC AND MANUFACTURING CO.



MANUFACTURERS OF EFFICIENCY ELECTRICAL DEVICES FOR CONDUIT WIRE AND CABLE SUSPENSION

DEPEND ON—INSIST ON—

P. R. MALLORY & CO., Inc.

MALLORY

Capacitors



Mallory Type "P" Capacitor:—Plastic case overcomes moisture absorption problems, and provides maximum insulation. May be used to replace cardboard insulated aluminum-case capacitors. Splash-proof plastic end cap and simplified "snap on" mounting bracket available when capacitor is used as original equipment.

Distributed by
INSULATION AND WIRES INCORPORATED
SAINT LOUIS 3, MISSOURI

BOSTON 20, MASS.
HOUSTON 2, TEX.

DETROIT 2, MICH.
BLUEFIELD, W. VA.

ATLANTA 3, GA.
NEW YORK 7, N. Y.

SITTLER COMPANY
CHICAGO 7, ILL.

H. A. HOLDEN, INC.
MINNEAPOLIS 3, MINN.

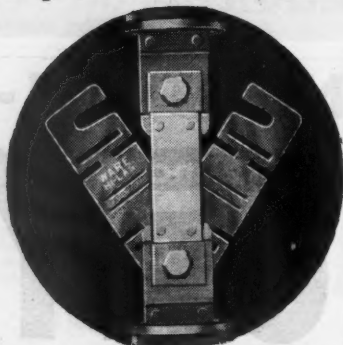
W. C. JOHNSON COMPANY
PEORIA 5, ILL.

TRI-STATE SUPPLY CORPORATION
LOS ANGELES 13, CAL. • SAN FRANCISCO 7, CAL. • SEATTLE 4, WASH.



WARE HI-LAG

Keep Motors Humming



KNIFE-BLADE ASSEMBLY
For Low Contact Resistance

Non Heating Wide Surface Area
and Quick Link Renewal



100% Quality

APPROVED BY UNDERWRITERS

WARE BROTHERS

4410 W. Lake St.

Chicago 24, Ill.

WARE
Renewable
HI-LAG FUSES

supplied by the power company to the primary of the transformers, it will be assumed that an unlimited or infinite supply is available. Therefore, only the transformer impedance limits the current, and a dead short on the secondary would produce a fault kva of:

$$\text{fault kva.} = \frac{\text{rated kva.}}{\text{impedance}} = \frac{4000 \times 2}{.05} = 160,000 \text{ kva.}$$

Primary fault current would be:

$$I = \frac{160,000}{1.73 \times 11,000} = 8380 \text{ amperes.}$$

The secondary fault current would be:

$$I = \frac{160,000}{1.73 \times 4100} = 22,250 \text{ amperes.}$$

Dropout type fuses usually do not carry such high interrupting ratings. However, other types are available and should be specified with the above ratings. Since this answer is only theoretical because of the assumption of unlimited supply, a 20,000 ampere rated fuse would undoubtedly meet duty requirements, as you are likely to have some impedance in the short circuit connection and also in the incoming line.—L.R.B.

Can you ANSWER these QUESTIONS

QUESTION V8—I have a series street light circuit of 52 lamps, 6.6 amps, that has shunt transformers in the fixture head. This transformer causes a lot of noise on the telephone line when the lamp burns out, but does not bother the radio. I would like to know where the trouble is, and how to overcome it.—R.T.L.

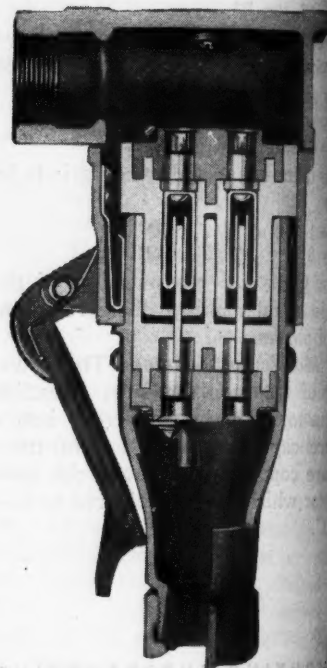
QUESTION W8—Our customers who have electric water systems on REA lines are experiencing a lot of trouble from lightning. What is the best method of protecting these from such damage? Can any effort be made to ground any portion of the wiring? If so, what type of ground should be used?—C.J.R.

QUESTION X8—We had an air blowing unit motor, of 1/20 hp., 1550 rpm., 110 volt, single phase capacitor motor with a speed control (a potentiometer type rheostat control). When the rotation was reversed, its speed dropped to about 35 percent of its nameplate reading. That is, the highest speed of the motor was at its low point and the speed dropping almost to zero as the speed regulator nob was turned to its high speed point. Upon dismantling the unit and testing out the motor, we discovered that the capacitor was short-circuited. Can anyone explain how this shorted capacitor affected this motor producing the mentioned effects?

PLEASE SEND IN
YOUR ANSWERS BY JANUARY 1

QUELARC

The circuit breaking plugs
and receptacles ...
ratings up to 200 amperes

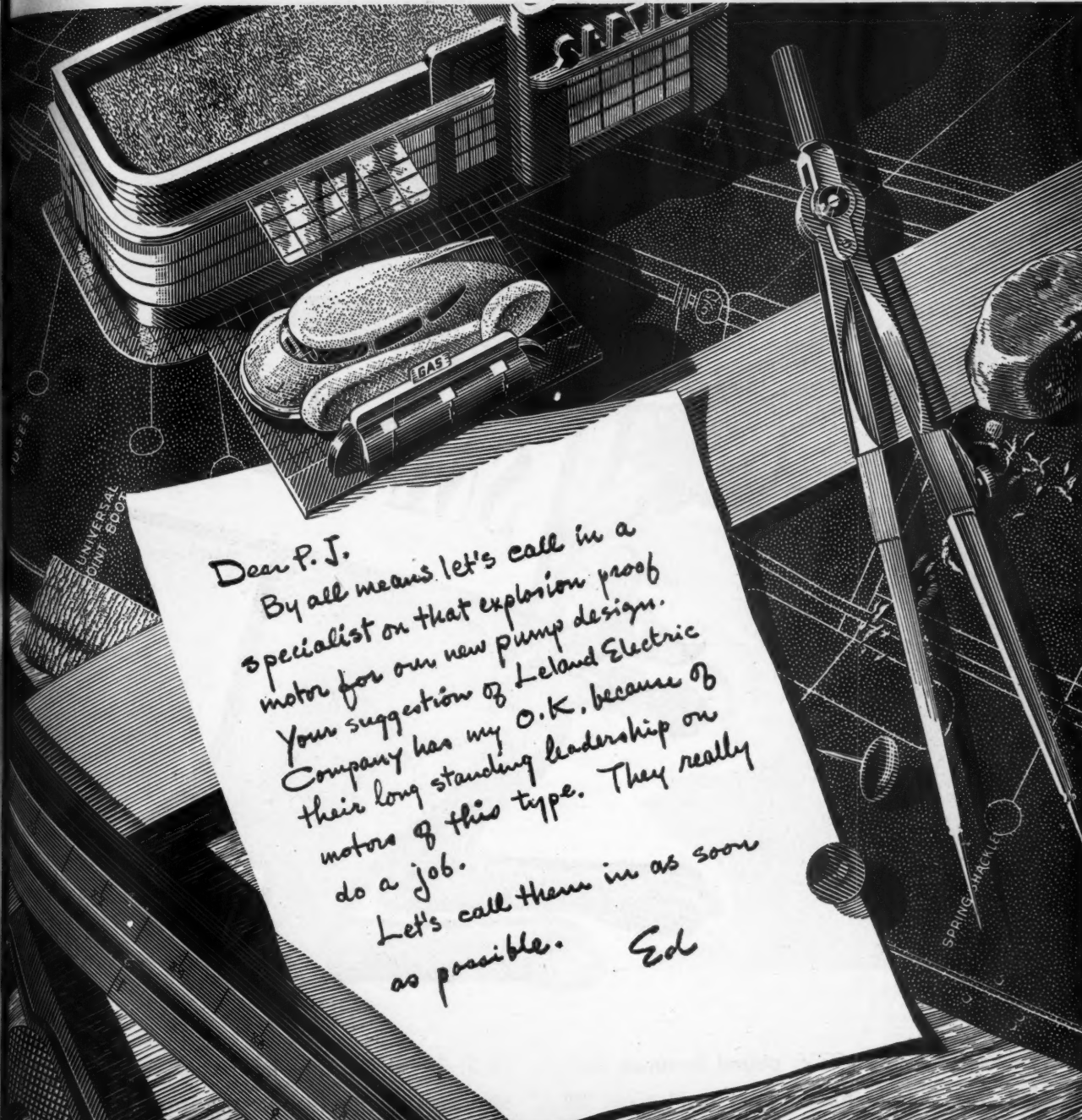


The exclusive Quel Arc construction provides exceptional protection to contacts for safe use as current rupturing devices. In the section view, note the complete enclosure of all contacts in insulating chambers which form an arc-trapping space. Note also the large distances from contact to contact and from contacts to ground. Contacts are individually renewable. Full ground protection is provided.

QuelArc plugs and receptacles are available in a complete range of styles, 2, 3, 4-wire types; ratings 20, 30, 60, 100 and 200 amperes. Consult your Pyle catalog for listings of all types.

THE PYLE-NATIONAL COMPANY

1344 N. Kostner Avenue, Chicago 51, Illinois



Dear P. J.
By all means let's call in a
specialist on that explosion proof
motor for our new pump design.
Your suggestion of Leland Electric
Company has my O.K. because of
their long standing leadership on
motors of this type. They really
do a job.
Let's call them in as soon
as possible. Ed

if it calls for
**CREATIVE ELECTRICAL
ENGINEERING...**
call for Leland!



THE Leland *ELECTRIC COMPANY*

DAYTON, OHIO • IN CANADA, LELAND ELECTRIC CANADA, LTD. ... GUELPH, ONTARIO



That's the way a 27½ pound hammer, falling free, hits in the "impact test" given all U. S. Royal Cords and Cables. As many as two thousand blows in rapid succession without the cable failing!

A whole series of such tests is made on

U. S. Royal Cables—heat, cold, compression, stretch—tests that prove the stamina to take rough treatment in the field.

Yes sir, these Royal Cables have everything you need for long, trouble-free service...you can specify them with complete confidence.

THE NEW U. S. ROYAL *Safety Tested* ELECTRICAL CORDS AND CABLES

Listen to "Science Looks Forward"—new series of talks by the great scientists of America—on the Philharmonic-Symphony Program. CBS network, Sunday afternoon, 3:00 to 4:30 E. S. T.

UNITED STATES RUBBER COMPANY

SERVING THROUGH SCIENCE

1230 Sixth Avenue • Rockefeller Center • New York 20, N. Y.



WITH ELECTRICAL WIRES AND CABLES

In Canada: Dominion Rubber Co., Ltd.

F. N. M. SQUIRES
Chief Inspector
New York Board of Fire Underwriters
New York, N. Y.

Answered by
and

GLENN ROWELL
Electrical Engineer
Fire Underwriters Inspection Bureau
Minneapolis, Minn.

QUESTIONS ON THE CODE

CABLE IN IRON PIPE

Q. "Does the electrical code permit installing inside a 1½ inch pipe fence railing which is 5 ft. high, a 14/2 armored lead covered cable to a momentary pushbutton which would be on a fence post, to operate 115 volt relay on an auto-call system for watchmen?"—T.M.

A. Armored cable is an approved wiring method for use where it is not subject to mechanical injury and as an iron pipe affords sufficient mechanical protection and is also large enough to pull the cable into it, it would not be a Code violation to do as suggested in the above question.

In the case as stated the iron pipe is not to be considered as a conduit but simply as a housing.

The leaded type of armored cable satisfies the requirements for damp location.—F.N.M.S.

CONTROL EQUIPMENT ON COMPRESSOR UNIT

Q. "We were given a rejection slip by the inspection department following the connection of a motor driven air compressor in a gas-line service station. This installation was similar to many we have made before where standard control equipment has been mounted on the compressor unit, yet we have been ordered to relocate these control devices so that they will be at least four feet above the floor. Is this a requirement of the National Code?"—P.H.H.

A. Undoubtedly the compressor unit you mention was located within four feet of the floor in a gas-line service station in which automobiles were serviced. If that is the case, Section 5103 of the N. E. Code would require that both the motor and its controller be of the totally enclosed type or be more than four feet above the floor. This is not a new regulation as it has been in force for quite some time; how-

ever, it is widely ignored and a great number of instances may be found where it has never been enforced.—G.R.

FARM WIRING

Q. "I have wired a considerable number of farms, but recently I was forced to resort to knob and tube installations on some as I could not obtain the usual cable. The first knob and tube job was turned down by the inspector with the statement that I had neglected to form drip loops where circuits extended from the cattle barn into the enclosed driveway. Does the Code require anything like that or is it just an inspector's idea?"—A.G.

A. The idea was not the inspector's. Under Section 3215 of the N. E. Code you will find the requirement he referred to. This section reads as follows: "Conductors entering or leaving locations subject to dampness, wetness or corrosive vapors shall have drip loops formed on them and shall then pass upward and inward from the outside of buildings, or from the damp, wet, or corrosive location through non-combustible, non-absorptive insulating tubes". Inasmuch as the atmosphere within the average dairy barn during the winter months is both corrosive and damp, the inspector was certainly justified in requiring drip loops wherever circuits pass from a warm to a cold portion of the building.—G.R.

TAPS TO POWER FEEDER

Q. "We have 440 volt, 3 phase, radial type main feeder for motor load. The feeder is three 500 MCM in 3 in. conduit with a 600 amp. circuit breaker for feeder over-current protection. The feeder is run on the ceiling, with junction boxes at 40 ft. intervals.

Please explain code requirements for

the size of motor branch circuit conductors and motor branch circuit protection for say a 2 hp. motor. The branch circuit safety switch will be located within 15 ft. of the feeder."—W.E.T.

A. Section 4349 of the Code governs the installation of taps as described above. If the taps to the main feeder for the individual motors were fused at the junction boxes mentioned No. 14 wire taps fused at 20 amperes could be used. Inasmuch, however, as the branch circuit protective device is located 15 feet away from this point the taps must have at least one-third the carrying capacity of the feeder.

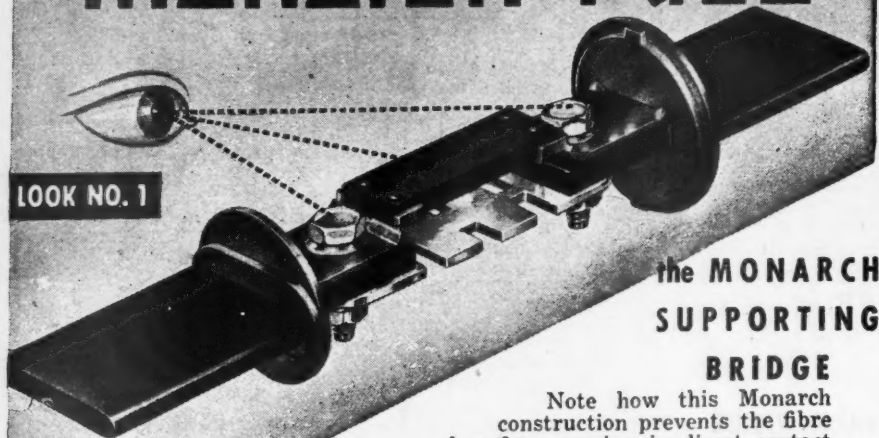
This would mean that the tap should not be smaller than No. 00 wire as evidently our inquirer is working on the 1937 table of carrying capacities in accordance with Interim Amendment No. 41 for type R wires. This tap would then terminate in a 2 hp. rated switch fixed at not over 20 amperes. The 2 hp. 440 volt, 3 phase motor should have running protection at not over 15 amperes and motor branch circuit protection at not over 20 amperes as indicated above.—F.N.M.S.

SERVICE EQUIPMENT INSTALLATION

Q. "I recently inspected an installation of new service equipment and found three 500,000 CM type RH conductors leaving a conduit run behind a switchboard. The end of the conduit had an ordinary metal bushing on it, so I requested that an insulating bushing be substituted for it in order that I might approve the job. Now should I have also required that an insulating fitting having separate openings for each conductor be used?"—B.A.

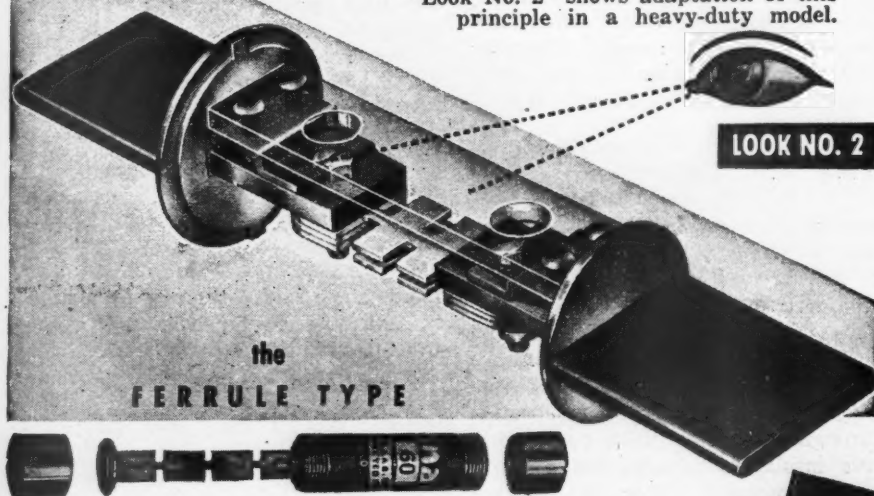
A. No, you were correct in asking for the insulating type bushing providing this conduit terminated be-

Take a TWO-WAY LOOK AT THE Monarch Fuse



Note how this Monarch construction prevents the fibre bar from coming in direct contact with the screw connecting renewal link to knife blade. This minimizes the charring of the fibre bar and positively prevents excessive overheating of knife blades. Note also large metal parts which dissipate heat. Result: dependable protection.

"Look No. 1" illustrates this construction in a lighter-duty Monarch knife-blade fuse and "Look No. 2" shows adaptation of this principle in a heavy-duty model.



*Specify Monarch Fuses
for improved*

FUSErvice



MONARCH FUSE CO., LTD.
118 E. FIRST ST., JAMESTOWN,

N. Y.



hind a switchboard and the conductors leaving the conduit terminated on the switchboard. If more than four conductors were involved in such an incident, they must be bunched, taped and painted with insulating paint. If the conductors are lead covered, then a metal bushing may be used. In all other cases where individual conductors leave a metallic raceway to change to open wiring or concealed knob and tube wiring a box or terminal fitting having a bushed hole for each conductor must be used. This fitting cannot be used to contain taps or splices and cannot be used at fixture outlets. These provisions may be found in Section 3015 and 3016 of the National Electrical Code.—G.R.

GROUNDING

Q. "Local R.E.A. inspectors are requesting that the ground wire at service entrances be attached to the neutral at the service cable head and run directly to the ground pipe below with the neutral bonded to the case of the service entrance switch in the usual way. But it is not necessary to connect switch case to the ground electrode. In other words it is not necessary to run the ground wire into the building.

"I have had several cases of trouble caused by poor neutral connections at the cable head with this type of grounding. If the neutral opened between the ground and the service switch the case would go 'hot' when any load was connected.

"Can you state any advantage economically or electrically in these 'Bureaucratic grounds' (as local contractors call them)?"—E.R.

A. It has always been the practice to run the grounding conductor from the supply side of the service switch. It has been considered the intent of the Code to require this connection at the service equipment by the phrase "on the supply side of the service disconnecting means".

There seems to be no objection to adding a grounding connection from the service cable head to the grounding electrode to augment the required grounding connection from the service switch.

The fact that serious trouble has been experienced in the field with the grounding connection at the service head proves that the connection "on the supply side of the service disconnecting means" is the proper method.

The only advantage to the service-cable head type of connection directly down to the ground electrode directly below, seems to this writer to be in the

No Electrical Equipment Made Can Be Any Better Than Its Insulation

NOW AVAILABLE!

As one of the world's largest and most experienced producers of insulating varnishes, General Electric supplied millions of gallons during the war.

research and manufacture... and meticulous adherence to rigid General Electric Quality Control precepts.

These varnishes helped protect vital electrical components in our fighting equipment... helped keep electrical equipment on the job for steady war production.

Now G. E.'s huge varnish production capacity—plus expert technical service—is available to peace industry.

G-E Insulating Varnishes met—often exceeded—exact military and naval needs. This was made possible by General Electric's 45 years' experience in insulating varnish

For full details consult your local General Electric Merchandise Distributor or write direct to Section RIMA-1255, Resins and Insulating Materials Division, Chemical Department, General Electric Company, Schenectady 5, New York.

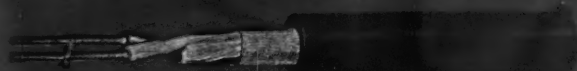
GENERAL  ELECTRIC

G-E INSULATING VARNISHES

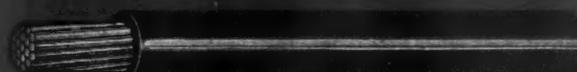
G. E. Offers a Complete Line of Insulating Materials

CRESCENT

Makes A Complete Line Of
ELECTRICAL WIRES & CABLES



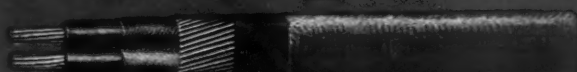
CRESCORD . Jacketed Portable Cord



SYNTHOL Building Wire - Types T & TW



Rubber Covered Building Wire and Cable



Service Cable - Types SE-U; SE-A; SD



CRESFLEX Non-Metallic Sheathed Cable



ABC Armored Cable

AND AMONG OTHER TYPES THE FOLLOWING:

Base Copper Wire & Cable
Strawbery Cord
Control Cables
Fire Alarm Cable
Fluorescent Wires
Flexible Cords
Flexible Steel Conduits
Sewer Cord
Sewerage Jacketed Portable Cable
PENACORD
Power Cables

Shipboard Cable
Signal Cable
Slow-Burning Wire & Cable
Toll-Backbone Wire & Cable
Telephone Wire & Cable
Thermocouple Cable
Trench Cable
Varnished Conductor Cable
Weatherproof Wire & Cable
Welding Cable

CRESCENT
WIRE AND CABLE
CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, N. J.

draining or carrying off of static or other electrical charges (not those of the Utility Company) during thunder storms.—F.N.M.S.

SERVICE SWITCHES

Q. "On an irrigation project we installed several 10 hp. 3 phase 230 volt motors on low lift pumps. These units were separately housed in small pump houses, and the service to each pump house supplied only the motor load, which according to the name plate amounted to 27 amperes. These motors are started at full voltage. The service switches installed were rated at 60 amperes and the fuses were of the lag type. No trouble has been experienced, but the engineer in charge has requested that I replace the 60 ampere service switches with 100 ampere units as required by the Code. If the motors operate without opening the fuses in the switches now installed, why should it be necessary to install the more expensive switches?"—M.D.

A. The proper answer to your question is dependent upon the specifications prepared for this irrigation project. If these specifications do not include the type and size of service switches, it is possible that you have correctly complied with the Code, providing conditions of maintenance and supervision on this irrigation project will assure that additional fuses suitable for the starting characteristics of the motors will be continually available. This provision may be found under Section 4347 of the N. E. Code.—G.R.

LIGHTING CIRCUIT

Q. "We are adding a new addition to our plant and plan to supply the electrical installation within by tying on to an existing three wire three phase 220 volt power service. Our present lighting service is loaded to capacity, and we were told that we could obtain lighting circuits from the power service by using auto transformers. After ordering these transformers, we have been advised by a local contractor that the National Electrical Code would not permit the use of an auto transformer supplied by two phase wires. Is that true?"—M.K.

A. Yes, an auto transformer must not be used to energize lighting circuits unless it is supplied from a wiring circuit containing an identified grounded conductor which is solidly connected to the identified grounded conductor of the lighting circuit or

How to be well read on the latest in motor-generator sets!



... full of up-to-the-minute information you should have, this book—"Robbins & Myers MOTOR-GENERATOR SETS"—covers mounting construction of 4-bearing sub-base, 2-bearing union-ring, and vertical union-ring sets, motor and generator voltages, mechanical features, ratings, and dimensions. In short, it contains the latest detailed data gathered from forty years of R & M motor-generator development.

By illustration, chart, and table, it gives you all the facts on fractional horsepower sizes from 50 to 500 watts and on integral types from 750 to 5000 watts.

Send for your copy, now. Write the Motor Division. Ask for Book No. 1881.

It's Free
24 pages of text,
tables, photographs,
drawings!



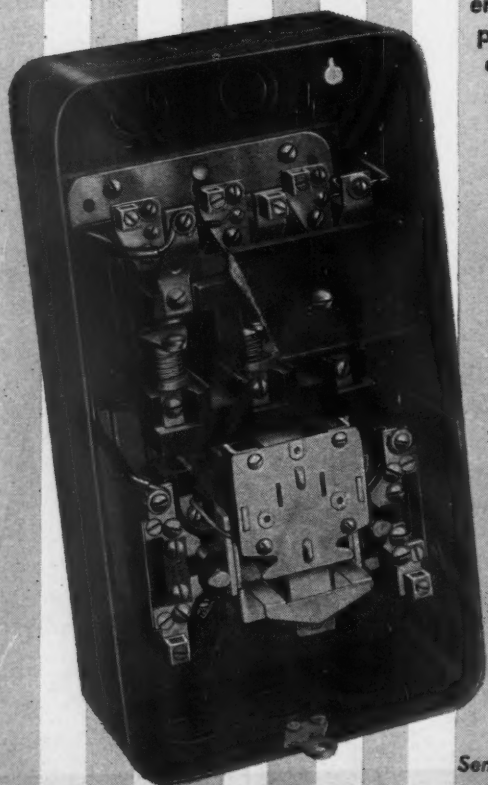
ROBBINS & MYERS • INC. MOTOR DIVISION • SPRINGFIELD, OHIO

In Canada: Robbins & Myers Co., Ltd., Brampton, Ont.

MOTORS • HOISTS • CRANES • MACHINE DRIVES • FANS • MOYNO PUMPS • FOUNDED 1878

Federal's Noark Magnetic Starter
Is completely different and plenty smarter
Equipped with action that's ball-bearing
For safe control and longer wearing

Federal NOARK Magnetic Motor Starters



There's only one moving part in Federal Noark Controls... and that part rolls on ball bearings—an exclusive Federal feature! Result? Smooth, faster making and breaking of contact, accurate action... less friction... longer life. Here are more reasons for specifying Federal starters:

- Double break pure silver contacts held by a single screw for ready replacement.
- Heavy arc barriers located for strength, flashover resistance, high arc rupturing.
- Molded parts have asbestos base with non-carbonizing inorganic binder.
- Coils readily changeable—just remove retainer spring, loosen yoke, take out magnet.
- Overload relays—combination hand and automatic reset. Bimetallic type. Originated by Federal.
- Heaters frontmounted, accessible; trip ampere stamped on units.

Send for your copy of the FEDERALOG.

FEDERAL ELECTRIC PRODUCTS COMPANY, INC.

EXECUTIVE OFFICES: 50 PARIS ST., NEWARK 5, N. J. • PLANTS: HARTFORD, CONN. • NEWARK, N. J.

circuits being supplied. In other words, an auto transformer can only be supplied by connection to one of the phase wires and the other tap must be made to an identified grounded conductor. This would necessitate running a fourth wire to the service equipment mentioned. This requirement may be found in Section 4508 of the N. E. Code. If the transformers were connected as you proposed, an accidental ground anywhere on your 220 volt system might cause a serious overload on the transformer.—G.R.

SECONDARY OF WOUND ROTOR MOTOR

Q. "We have a 50 hp, 440 volt, 3 phase wound rotor a-c motor rated 69 amps. full load current, and 140 amps. full load secondary current, secondary voltage 170. The motor will be used for driving a small rubber mill, and the secondary circuit is used for starting duty only, approximately two or three times per day. We do not understand the code requirements for the size conductors required between the secondary of the wound rotor motor (slip rings) and the controller, as set forth in sections 4312 and 4313. Please state size secondary conductors required and the method of determining the size."—W.E.T.

A. We understand that in the case stated above the wound rotor winding is used only for starting duty and that the rolls can be lifted during the starting period and that the starting occurs only a few times per day.

This then would indicate that the duty on the secondary circuit would be classified as "light starting duty" and permissible to use the table in section 4313 and use conductors having a carrying capacity of 35 percent of the full load secondary current.

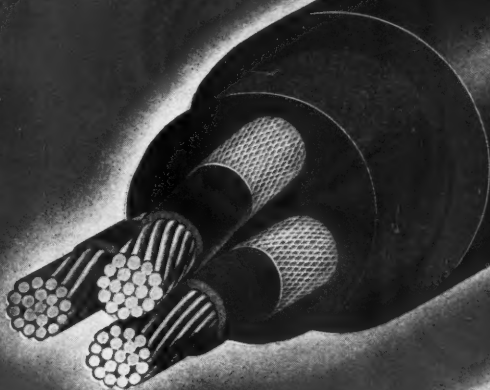
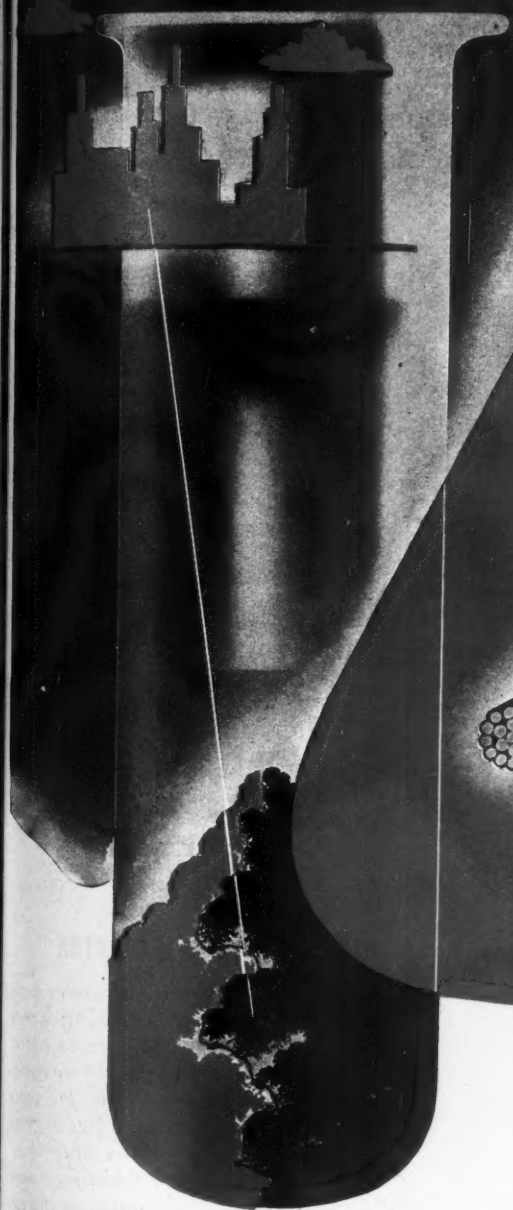
In the case mentioned above with 140 amperes of full load secondary current the conductors should be not less than $140 \text{ amps} \times 35\% = 49 \text{ amps}$, in which case No. 6 Type R wires could be used.—F.N.M.S.

WHAT IS A PORTABLE MOTOR?

Q. "In a small wood working shop I was recently detailed to install a number of small wood working machines, such as are bought by hobbyists for home use. The motors on these are from $\frac{1}{4}$ to $\frac{3}{4}$ hp. maximum.

The owner of this shop wished to have these machines left portable so they could be moved around the shop

ENGINEERING RESEARCH . . .



Thermoplastic insulation specialists . . . producing a complete line from fine wires to heavy power cables . . . serving: Public Utilities, Radio, Electronic, Appliance and Instrument Manufacturers, Telephone Companies and Contractors.

There is no substitute for engineering. Nationally recognized engineering talent . . . PLUS exclusive equipment, careful materials control, and exacting inspection . . . explain PLASTIC'S amazing achievements in the design and production of thermoplastic insulated wire and cable. This engineering "know how" is at your command . . . for today's planning or tomorrow's production. Write for complete information and samples engineered to fit your particular requirements. Remember . . . when you're thinking of PLASTIC you're thinking of US!

PLASTIC

WIRE & CABLE

CORPORATION

NORWICH CONN

DAVIS

TRANSFORMERS DRY TYPE TRANSFORMERS FOR POWER AND LIGHTING LOADS

CHANGE FROM
POWER — VOLTAGE
230 or 460

CHANGE TO
LIGHT & POWER
115/230



UNIT ILLUSTRATED IS FOR WALL, POST
OR FLOOR MOUNTING FROM 1/2 KVA TO 10 KVA.
OTHER DAVIS DRY TYPES FOR ALL PURPOSES
ORDER NOW! STOCK SHIPMENTS



**DAVIS
TRANSFORMER CO.**
Phone 177 CONCORD, N. H.



STOCKWELL TRANSFORMER CORP.

CONCORD, N. H.—Phone 177 AKRON, OHIO—Phone Jefferson 4179

Manufacturers of Oil Cooled, Dry Type, Power and Distribution Transformers
Also All Types of Specialty Transformers Regardless of Size

for convenience. I therefore proposed to install ten 15 amp. receptacles on posts, a circuit for each receptacle and a proper cord connection from the receptacle to proper disconnect switch on each machine with thermal protection.

The proposed installation was disallowed and Paragraph 4439b was quoted as prohibiting any motor of over 1/2 hp. from being portable. I am not at all satisfied that this ruling was right. There are no local ordinances covering this subject. What is your opinion?
—H.W.H.

A. The Code does not limit the size of portable motors according to their hp. ratings.

A portable appliance whether motor driven or not, is defined in Art. 100 as "an appliance capable of being readily moved where established practice or the conditions of use make it necessary or convenient for it to be detached from a source of current by means of flexible cord and attachment plug." There are many portable appliances with motors much larger than 1/2 hp. which are portable and also many with smaller motors which are not portable.

Section 4439 sub paragraph b has nothing to do with portability. Sections 4435 to 4439 inclusive deal with grounding. These sections govern when and how motor frames of all voltages are to be grounded.

The original plan with consideration for the presence of sawdust seems to be feasible.—F.N.M.S.

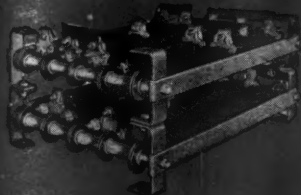
WIRING A GRAIN ELEVATOR

Q. "I plan to wire a country grain elevator and the REA line crew set the last pole on the wrong end of the building as I feel the service equipment should be located in the office since that is the only area free of grain dust. Now if the service drop is attached to the end of the building nearest the pole and then run along on the exterior of the elevator, will it be necessary to support these individual conductors every four and one-half feet or may I make use of racks spaced at greater intervals?"—H.P.

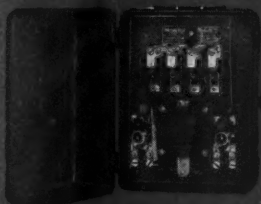
A. Section 2333 of the N. E. Code answers your question. In this section you will find permission to use wire rack or other means of support spaced at intervals of 15 feet if the conductors are spaced 12 inches from each other and 2 inches from the surface of the building. If the conductors are spaced 6 inches apart, the supports must be within 9 feet of each other and for 3 inch spacing between conductors the supports must be spaced at 4 1/2 foot intervals.—G.R.

For Advanced Design Monitor Leads-Every Time!

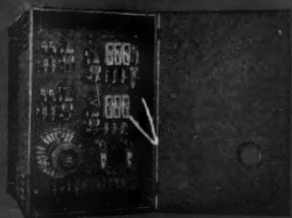
Push button control stations of all types.



Resistors—Ragwound, Hex-wound and Smoothwound types.



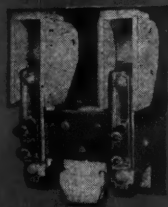
A. C. and D. C. Motor Starters... across-the-line, reversing, non-reversing and combination units.



Manual speed regulating controls.



Heavy Duty V8 control stations built to prevent accidental starting and stopping by operator.



Custom-built for A. C. and D. C.

That's Why Monitor Rates First With Thousands of Motor Control Buyers

No wonder Monitor rates high with men who know what a big difference modern, advanced design of motor control equipment can make in operating costs.

Providing industry with advanced designs has been Monitor's major objective for over 56 years. Many of the more recent ones can be particularly helpful as part of your plant reconversion program . . . in terms of lower costs and higher production.

Printing presses, machine tools, ventilating fans, pumps, dairies—these are just a few of the applications where Monitor designed control equipment can prove especially advantageous.

So whatever your needs . . . standard units like those shown at left or custom-built units which control entire multiple operations . . . see your Monitor Field Engineer first.



ONLY COMPANY IN THE
MOTOR CONTROL INDUSTRY
TO RECEIVE THE
MARITIME "M"



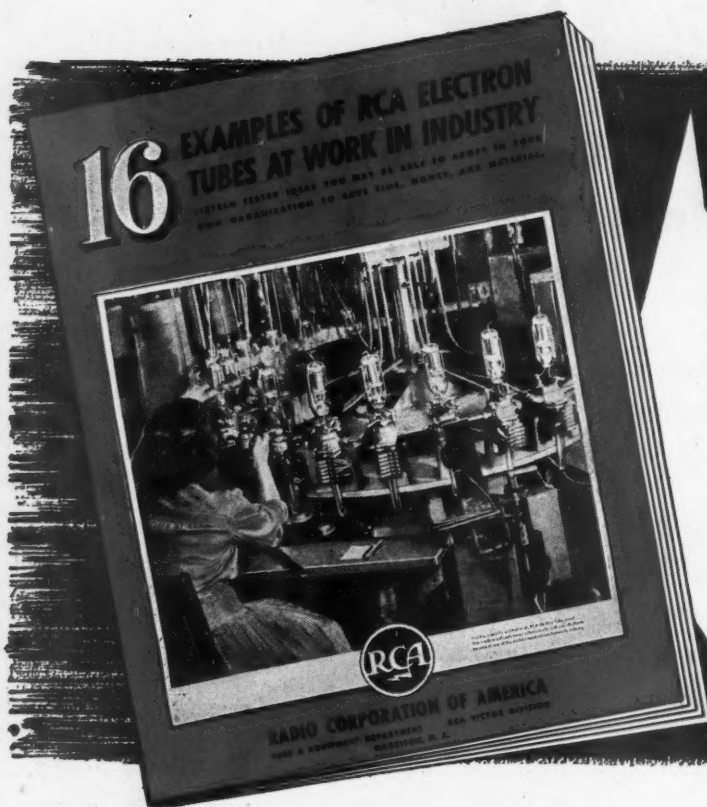
The Monitor Controller Company

GAY, LOMBARD & FREDERICK STS. BALTIMORE-2, MARYLAND

CANADIAN AFFILIATE • CANADIAN CONTROLLERS LTD. • TORONTO, ONTARIO, CANADA

FREE TO INDUSTRIAL ENGINEERS AND EXECUTIVES

20-page booklet showing how electronic equipment is being used in industry today—to cut costs, increase production, and improve product quality



CONTENTS—How Electron Tubes . . .

- protect workers
- analyze colors
- control lighting
- provide high-speed switching
- "time" machine-tool operations
- speed wood-bonding 700%
- sort mountains of beans
- provide split-cycle timing
- speed soldering 2400%
- direct traffic
- prevent fire and explosion
- speed surface hardening
- test springs
- dry penicillin 4700% faster
- prevent paper waste
- detect hidden flaws in metal

HERE—in convenient, easy-to-read form—are sixteen authentic case histories, telling how different industrial electronic devices work, and how they have saved time, money, and materials, for many different industries. Simply written, non-technical, illustrated, these case histories contain many ideas that may be useful to you.

What the booklet can do for you—Any of the ideas discussed in this booklet may suggest ways in which your company can adopt electronic methods to save money, increase production, perform manufacturing operations not possible by other means—or ways in which electronic

devices can be designed into the products you manufacture to provide improved performance.

Authentic case histories—Case histories like these, which have appeared in RCA advertising for over two years, have attracted much favorable comment from industrial engineers and executives. Because the information they contain has proved so useful, 16 of the most popular applications have been reprinted in this 11" x 14" booklet.

Send for YOUR copy today—For your free copy of this booklet, write to us for "16-Examples Booklet," or simply attach the coupon below to your company letterhead. Please indicate your position, and mail it to us today.

MAIL TODAY WITH YOUR COMPANY LETTERHEAD

Radio Corporation of America
Commercial Engineering Department, Section 62-625
Harrison, New Jersey

Your booklet, "16 Examples of RCA Electron Tubes at Work in Industry," containing authentic case histories of industrial electronic applications (with photographs, drawings, diagrams, etc.) is of interest to our company. Please send my free copy to:

Name

Position

Address

City..... Zone..... State.....

62-6256-62

The Fountainhead of Modern Tube Development is RCA

BUY BONDS

AND

KEEP 'EM!



RADIO CORPORATION OF AMERICA

TUBE DIVISION, HARRISON, N. J.

VES ELECTRONICS

The Maintenance and Servicing of Sealed-Ignitron Rectifiers—Part IV

L. W. Morton
Industrial Engineering Division
General Electric Company
Schenectady, New York

It was stated in Part I that troubles rarely occur with sealed-ignitron rectifiers, and in introducing Part IV, "Trouble-Hunting", it is desirable that this point be again emphasized. Furthermore, the rare cases of trouble can be diagnosed and remedied easily on such electronic equipments because they are fundamentally simple. The maintainer should, however, understand the equipment and be forewarned of the possible troubles that may develop, if he is to take full advantage of this simplicity. Part IV should equip the maintainer with the needed information concerning these troubles; and thus the user will be assured that he will obtain from the rectifier the maximum of reliable service.

While apparatus trouble is always a matter of great concern to the operating department, to a maintainer it often has its appealing aspects. In fact, to a good maintenance engineer, finding and correcting trouble in electric apparatus has the same appeal that an unsolved crossword puzzle has to a confirmed addict of this pastime.

Hunting trouble is the proving field wherein the maintainer's self-preparation, experience, and native ingenuity are tested. It gives him an opportunity to exercise his imagination, too—but for practical objectives. Usually hunting for trouble also carries with it the excitement of a race, because the maintenance man must pit all his facilities and resourcefulness against the demands of the operating department to return the equipment to productive service in the shortest possible time.

Test Instruments—The question of what test instruments should be available is always an important problem. Usually the maintenance man, who invariably has a natural liking for an

array of fancy instruments, will want more than are really justified. There is, however, a minimum number which should be available. These are:

1. Oscillograph—Either string galvanometer type instrument or cathode-ray oscilloscope is satisfactory. However, the cathode-ray type is much less expensive. There are many grades of such instruments, the price depending principally on the size of cathode-ray tube screen. Any one of the different sizes is useful, but the larger the screen the better.

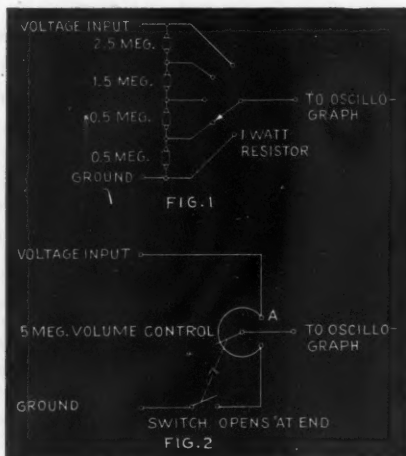
2. Analyzer—An analyzer is a multimeter instrument containing circuits which can be selected for measuring the following phenomena: volts, ohms, and current.

3. Homemade Magnetic Links and a

Compass—This combination of home-made magnetic links and compass is used for measuring surge currents through the tubes when looking for the faulty tube in cases of frequent arc-back. The magnetic links can be made from ordinary hack saw blades. About twelve pieces of hack saw blade, each $1\frac{1}{2}$ inches long, should be prepared. Then each one of the twelve pieces should be coated at one end with white paint, to indicate polarity.

Following is a list of instruments suitable for ordinary maintenance work on even the largest installation of sealed-ignitron rectifier equipments. (It should be understood that this list does not contain test equipment for maintenance and servicing the transformers or switchgear, nor does it contain apparatus for determining withstand voltage levels):

- a) A-C voltmeter, 600 volts.
- b) A-C ammeter, 5 amps.
- c) Analyzer.
- d) Hook-on ammeter. It should be capable of reading currents up to 600 amps, rms.
- e) Oscillograph. When a cathode-ray instrument is used for testing rectifiers, there are certain accessories which should be available. Potential dividers of the type shown in Figs. 1 and 2 are useful. An ordinary cathode-ray oscillograph is not designed for observing d-c voltages because a protective capacitor is connected in series with the input signal circuit. This internal capacitor should be reconnected so that it will be used only in the test circuit when the amplifier is used. In most cathode ray oscillographs the amplifier is designed for a-c operation only. If the maintainer does not understand how to modify the circuit of the



FIGS. 1 and 2—Potential divider circuits for oscillograph input.



Versatility-Plus !

BULLDOG BUSTRIBUTION DUCT FOR "PLUG-IN" POWER . . . ANY TIME . . . AT ANY POINT

Conversion goes on **ALL THE TIME** in industrial plants—not just during or after a war.

Production lines must constantly be re-arranged to meet new or altered manufacturing schedules. Machines may work in many different locations during their service lifetime.

With old-type *fixed* outlet systems, re-wiring to accommodate these changes is slow and costly. Not with Bulldog BUSTribution Duct—the orig-

inal "plug-in" system gives you electrical power *whenever* and *wherever* you need it.

This system—result of half a century of leadership in the electrical distribution field—gives you the finest *flexible* set-up for all your power needs. It's *plus* in everything but price—100% salvable, too.

Investigate BUSTribution Duct for *your* plant. Consult Bulldog field engineers or write us direct.

BUY VICTORY BONDS

SALVAGE PA

DETROIT 32, MICHIGAN.
In Canada:
Bulldog Electric Products of
Canada, Ltd., Toronto.
Field Offices in All Principal Cities.

BULLDOG

ELECTRIC PRODUCTS COMPANY



Also Manufacturers of
Vacu-Break Safety Switches—Softstart
Panelboards—Switchboards—Circuit
Master Breakers—Industrial Trol-E-Duct for
moving "loads"—Universal Trol-E-Duct for
completely flexible lighting.



FIG. 3—Delta six phase double wye rectifier power circuit (left) and the principal wave shapes (right).

cathode-ray oscilloscope so as to read d-c voltages, instructions should be obtained from the oscilloscope manufacturer. Furthermore, some cathode-ray oscillographs do not have facilities for synchronizing the sweep wave with the input (usually 60-cycle) supply voltage. In these instruments changes may be made so that the sweep voltages are taken from the 6-volt tube heater circuits. The internal synchronous sweep circuit should be open-circuited when the 60-cycle sweep is applied so that two synchronous signals will not be applied simultaneously, to sweep circuit.

f) Surge crest magnetic links, surge crest ammeter, and demagnetizing coil. These instruments are commercial versions of the homemade hack saw blade magnetic links and compass described previously (Fig. 2A).

g) Other devices to aid in quickly locating control circuit opens and shorts such as bell ringers and neon tube voltage testers.

Observation of Normal Instrument Readings and Wave Shapes

A good way to prepare for rapidly locating possible trouble is to have complete records on what the normal voltage and current readings and wave shapes are in the various parts of the main rectifier power and control circuits. Obviously, most electrical troubles cause abnormal wave shapes in the power rectifier circuit, and if the maintainer has records available showing what the normal conditions are, it is a simple matter to compare abnormal observations with them and thus determine the exact location of any trouble.

As an example, Fig. 3 shows the popular Delta, 6-phase, double-wye rectifier power circuit and the normal wave shapes in important parts of the circuit as they would be observed by oscillograph. If the power circuit of the rectifier equipment, which is under

the care of the maintainer, is not the 6-phase double-wye, normal wave shape records for various parts of the circuit should be made for subsequent possible use in case of trouble. The maintainer should practice the use of the oscilloscope enough to be capable of handling it efficiently when the need arises.

It is always good practice to insulate the cathode-ray oscillograph from the 110-volt service connection that is used for supplying its excitation, by means of a small 1:1 ratio insulating transformer. This is because when the cathode-ray oscillograph is used to measure rectifier circuit voltages the instrument may be exposed to higher voltage than its internal insulation can withstand. Test leads should be attached to insulating handles to protect the person who holds the leads during any measurement (Fig. 3-C). Most

cathode-ray oscillographs have about 200-volt a-c full scale screen deflections. Therefore, potentiometer circuits such as illustrated in Figs. 1 and 2 should be added when the voltage to be measured exceeds 110 volts.

When oscillographic observations of current are made, it is necessary to use a shunt. This shunt can be any non-inductive conductor producing a voltage drop of 50 to 100 millivolts when the current to be measured is passed through the shunt. The oscillograph leads should be carefully twisted all the way from the center of the shunt to the instrument terminals to avoid inaccuracy from magnetic pick up by the leads. The amplifier circuit must be turned on when measuring currents in order to obtain reasonable deflection on the screen.

Wave shapes shown in Fig. 3

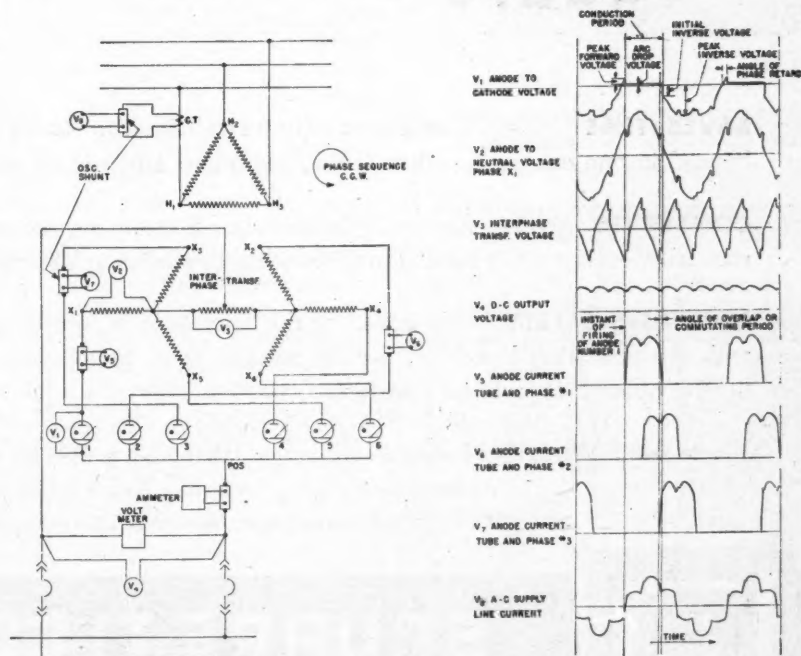


FIG. 2 a—Surge crest magnetic links, surge crest ammeter and demagnetizing coil are instruments useful in test work.



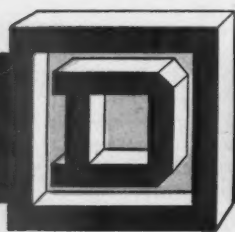
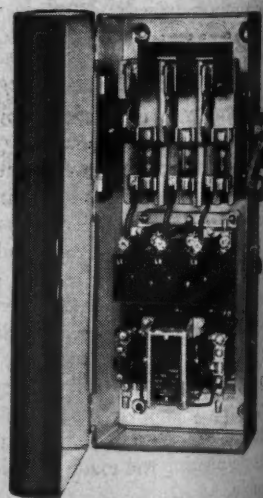
3 important advantages in this installation of Square D Combination Starters

SAVES TIME Disconnect Switch and Magnetic Starter are housed in one enclosure—thus saving mounting and wiring time.

CONSERVES SPACE Square D Combination Starters require substantially less space than individually mounted switches and starters.

INCREASES SAFETY The cover of the enclosure is interlocked with the operating handle of the disconnect. Thus, the cover cannot be opened on a "live" starter.

Write for Bulletin 8538 which gives details and illustrations of complete line.
Address Industrial Controller Division, Square D Company,
4041 North Richards Street, Milwaukee 12, Wisconsin.



SQUARE D COMPANY

DETROIT

MILWAUKEE

LOS ANGELES

illustrate rectifier operation with a moderate amount of phase control. The triangular peak of voltage identified by the words "peak forward voltage" on trace V, is always observable when there is any phase retard. If the rectifier were running fully advanced, the flat line, identified by the words "arc drop voltage" would extend all the way across the positive part of the wave, and there would be no so-called "peak forward voltage" triangle.

It is sometimes desirable to be able to estimate quickly the amount of phase control. Amount of phase control can be estimated by measuring the "rectified d-c output volts" by means of d-c voltmeter, and the magnitude of "Peak Forward Voltage" and "Peak Inverse Voltage", as illustrated by the trace of anode to cathode voltage "VI", Fig 3B under the same operating conditions. These values should then be substituted in the following formulae:

$$\begin{aligned} \text{Angle of retard (degrees)} &= \frac{\text{Peak Forward Voltage}}{\text{Peak Inverse Voltage}} \\ \text{Maximum Output Volts} &= \frac{\text{Rectified d-c output volts}}{\cosine \text{ angle of retard}} \\ \% \text{ Phase Control} &= \frac{\text{Maximum Output Volts} - \text{Rectified d-c output volts}}{\text{Rated d-c Output Volts}} \times 100 \end{aligned}$$

In addition to making reference records of the rectifier wave shapes indicated in the foregoing, it is desirable to record measurements by means of portable test instruments of the normal voltage and current relationships in the rectifier power circuit. Study of the wave shapes in Fig. 3 will indicate that ordinary portable testing instruments should not be used to measure some of the circuit voltages and currents. For instance, there is no indicating instrument which will measure anode to cathode voltage and give results which mean anything. Ordinary d-c voltmeters, however, can be used to measure anode to neutral voltage, interphase voltage, transformer primary voltage, etc. Transformer primary currents can also be measured by standard instruments. As previously stated, the hookup type ammeter may be used for anode current study only because it indicates relative tube current balance. The numerical magnitudes of these hook-on ammeter anode measurements are neither average nor root mean square values.

Locating and Correcting Troubles in Sealed-Ignitron Rectifiers

Arc-Back Interruptions

An arc-back is a failure of rectifying action which results in the flow of a principal electron stream in the reverse direction, because of the forma-

tion of a cathode spot on an anode. When such an event occurs, there is a short-circuit a-c current and usually a reversal of d-c current flowing from the rectifier. These high currents trip both the a-c and d-c power circuit breakers, disconnecting the rectifier, or when high speed anode breakers are used, disconnecting the offending tube from the systems. Usually the breakers may be reclosed at once; either manually or automatically, and normal service restored.

Arc-backs are more likely to occur on higher d-c voltage rectifiers than on low voltage. For instance, arc-backs on 125- or 250-volt rectifiers are rare, but they may be expected occasionally when the same tubes are used for 600 volts. Likelihood of arc-back is increased for prolonged overload. Several other factors may tend to cause arc-back, and these will be discussed in detail later in this article.

When the end of usable tube life is caused by arc-back, such arc-backs usually occur directly the rectifier is placed in service after it has been out of service for some time. In this respect tube failures are often like incandescent lamp "burn outs". It is well known that the majority of the electric lamps burn out at the very instant they are turned on. This characteristic is fortunate, for it means that in the case of ignitron tubes the operator will usually be close at hand and the rectifier can, therefore, be placed back in service sooner or the tube replaced more quickly as a result.

The amount of overcurrent which flows during arc-back is large. In the a-c lines supplying the primary of the rectifier transformer, values as high as 15-20 times normal may be encountered. Overcurrent through the tubes themselves varies, depending on whether or not power can feed back through the faulty tube from the d-c system. Arc-back current through faulty tubes has been measured at from 25-90 times normal, depending on the d-c voltage level and amount of d-c feed back. Current in the normal tubes, which also, of course, contribute current to the faulty tube, (see Fig. 5 Part III of this series of articles) may reach 20-30 times normal.

Obviously it is essential that the protective switchgear interrupt such high current as rapidly as possible. When semi-high-speed switchgear is employed, the d-c breakers should open in not longer than .03-.05 seconds and the a-c breaker within 0.15 seconds. Semi-high-speed switchgear is usually adequate for sealed-ignitron rectifiers. In cases where, for special reasons, it has been necessary to supply high-speed switchgear, the breakers should discon-

nect the faulty tube in approximately 0.016 seconds. The maintenance man should always see that the overcurrent relays and power circuit breakers are adjusted and calibrated to achieve the functional operation specified by the manufacturer, which will usually conform to the above rules.

Arc-Back Caused by Leaky Tubes

One important cause of arc-backs is leaky tubes. There are several ways of determining if tubes are leaky. These tests are:

a) Leaky tubes may sometimes be identified during operation by an unusual pinkish tinge in the otherwise characteristic blue color.

b) If a particular tube is suspected, it may be removed and a "click test" applied. This consists of rocking the tube back and forth and listening for the click or impact of the mercury when it splashes about in the tube. If air or gas is present it will cushion the impact and no "click" will result.

c) A test similar to (b) consists of inverting the tube, thus letting the mercury run into the glass anode seal. If this traps any "bubbles" which escape past the glass, it indicates the presence of air or gas. A tube which has had this test applied to it may arc-back a few times when it is first returned to service.

d) Occasionally leaks are produced by cracks in the glass seals which are large enough to be observable, if carefully inspected.

e) A high frequency spark coil will indicate gas in the tube. The device should be adjusted to give a spark one-half inch long. Then the pointer should touch the glass anode seal midway between the metal parts, and if gas is present it will produce a glow in the tube.

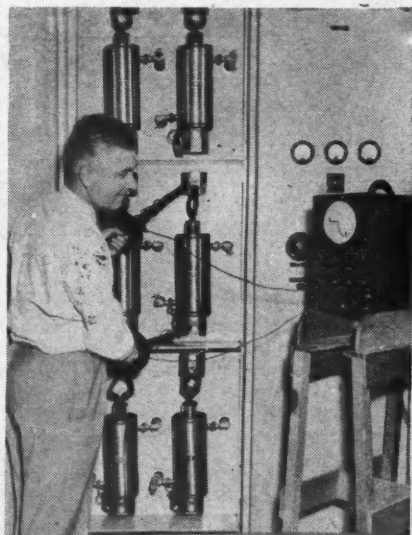


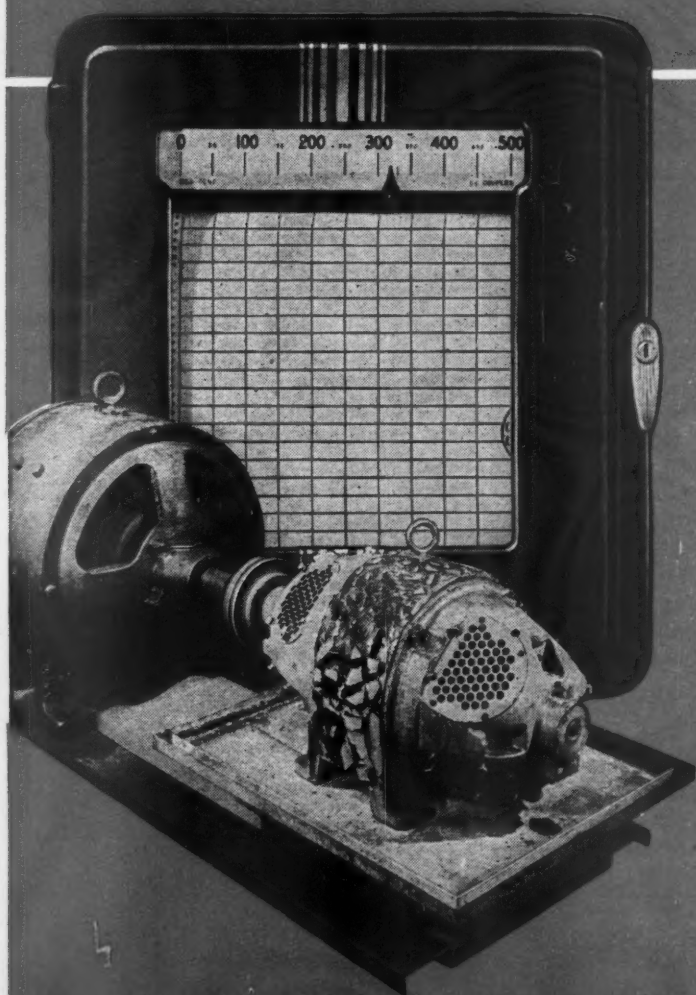
FIG. 3C—Test leads are attached to insulating handles for safety.

DC

DOW CORNING

SILICONES

increase permissible operating temperatures by more than 100°C.



IN THE ELECTRICAL INDUSTRY, FOR EXAMPLE

This test motor wound with Silicone Insulation has been alternately saturated with moisture and operated at 310°C. (590°F.) by resistance, for a total of 2,000 hours with no sign of failure. Silicone Insulation means reliable and continuous operation under most adverse conditions.

DOW CORNING CORPORATION
MIDLAND, MICHIGAN
NEW YORK OFFICE, EMPIRE STATE BUILDING

Today many accepted engineering limitations are being swept away by revolutionary new Dow Corning silicone materials. Designers are making major product improvements—coupled with important economies—never before possible.

Here's a specific example. Dow Corning varnishes and resins—because of their unique resistance to high temperatures—make it possible to redesign or rewind electrical equipment for increased horsepower output per unit weight. At the same time they greatly prolong equipment life under adverse operating conditions and reduce overload failures and fire hazards.

The recent development of IE 996, a Silicone Varnish which cures at 300°F., enables any electrical maintenance or rewind shop to secure the greater operating economies of Silicone Insulation.

In other industries Silicone materials also make possible operations which were previously impossible or very expensive. Consult Dow Corning for particulars.

Dow Corning

FIRST IN SILICONES

f) The best test is a high potential test. A high reactance ignition type test transformer capable of 12,000 volts rms should be used and a 25.0 milli-ampere ammeter connected in series with 10,000 ohms in the high voltage leads to the tube. One lead goes to the anode, the other to the cathode. Voltage is increased rapidly to 12,000 volts. Even good tubes may "break down" or "clean up" for an instant. However, if at any time the milliammeter reads substantial current for more than five seconds, the tube may be classed as gassy or leaky. A good tube should withstand 12,000 volts, 60 cycles for one minute. Gassy or leaky tubes should be replaced when detected.

Arc-Back Caused by High Vapor Pressure

Experience has proved that arc-back sometimes occurs when the mercury vapor pressure is too high. The pressure of the mercury vapor in the tube depends on the water temperature, the pressure doubling for every 10° C increase in water temperature. It may also increase because of overload when the load is so high that the arc losses exceed the cooling ability of the water jacket.

Arc-back is to be expected when vapor pressure exceeds values corresponding to 80° C or when long periods of overload exceeding 50 percent are encountered. Therefore in case of unexplained arc-back, the operating conditions should be carefully examined by the maintenance man to be sure that over-temperature or overload are not the cause.

Arc-Back Caused by Dirt in Tube

One theory of the cause of arc-back is that a small particle of insulating material 10⁻⁶ cm diameter or less in size is attached to the anode. This

particle, under the right conditions, may become so charged by the surrounding ionized plasma that a high enough potential gradient exists between it and the anode to draw out electrons from the anode surface. Such an event reverses the flow of electrons and becomes an arc-back. Therefore when a tube becomes dirty internally from long use, excess overload, combined excess overload and phase control, or simply by accident, it is likely to arc-back. Such tubes must be replaced.

Arc-Back Caused by Excess Phase Control

Tests have proved that arc-back probability is increased in proportion to the product of the peak inverse voltage times the rate of change of current at the end of commutation. The magnitude of this product increases rapidly when the amount of phase control is increased. Therefore under certain combinations of load and excess phase control, arc-back may result. When unexplained arc-backs are occurring, investigation for this possibility is in order.

How to Identify a Tube Which is Causing Arc-Back

There are several methods of identifying a faulty tube. These methods vary from simple inspections of the tube to carefully carried out tests. A description of these methods follow:

Inspection of the Tubes

Sometimes faulty tubes can be picked out of the group at a glance. There are two telltale indications to look for. One is the pink-blue color of the arc, which indicates leakage and which has been described previously.

The other indication is for one of the tubes to have a dense dark coating on parts of the inside of the glass anode seal. Ordinarily, this coating does not develop unless a tube has arced back frequently, passing high arc-back current.

Note: A uniform over-all darkness of the glass seal does not necessarily mean defective quality of the tube.

Trial and Error Tube Replacement

Often the faulty tube can be weeded out of the group by a trial and error tube replacement schedule, using one or more of the spare tubes. The more spare tubes used the sooner will the faulty tube be eliminated.

First, the arc-back records should be examined to determine the prevailing frequency of arc-back. Then a tube or tubes picked at random from the group of tubes in the rectifiers are replaced by tubes from the spare stock. These tubes should be new or, if not, have

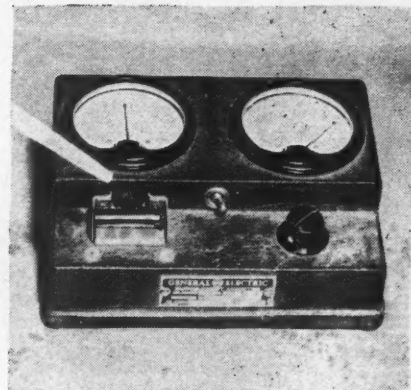


FIG. 3-E.—Magnetic links are placed in surge crest ammeter for reading.

established performance records free from arc-back.

Operation should then be watched for a sufficient length of time to find out by comparison with the previously established arc-back frequency rate whether or not there has been improvement.

By proceeding to rotate the tubes from position to position in this manner, usually a change in arc-back rate can be ultimately associated with some particular tube. This tube should be permanently replaced.

Magnetic Links and Surge Crest Ammeters

The magnetic link method makes use of the fact that the extremely high arc-back current is in the reverse direction from normal. The commercial type of magnetic links are high grade permanent magnets made of cobalt steel. When placed near a conductor carrying 300 to 70,000 amperes, they become magnetized in proportion to and in the direction of the current flowing in the conductor. A reading of the magnetic link is taken by placing the link in the test clip of the surge crest ammeter, where both the magnitude of the current surge and its direction are indicated.

When used as arc-back indicators, the links are placed near the anode cables or anode terminal of the tube with 1/2-inch to 1 1/2-inch separation (Fig. 3-D). It is advisable to use a suitable metal clip to hold the distance between link and cable fixed. The magnetic links have red compound, at one end only, to indicate polarity, and all links should have the red ends pointing magnetically in the same direction for all tube positions.

After an arc-back, the links should be removed before returning the rectifier to service. As the links are taken from the anode cables they should be placed in magnetic shields which are numbered to correspond with the tube position from which the link was removed. The links are then tested in turn with the shields off (Fig. 3-E).

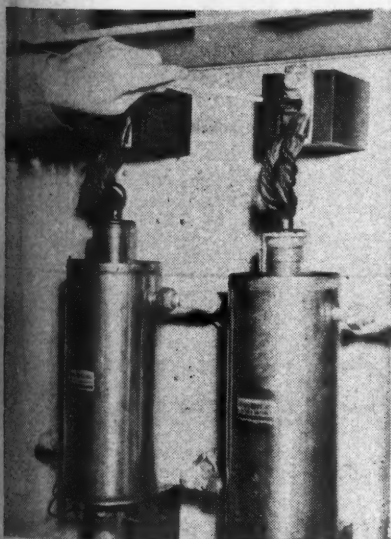


FIG. 3-D.—Magnetic links are placed near anode for arc-back indicators.



*P*ease and rest at length have come
All the day's long toil is past
And each heart is whispering "Home,
Home at last"

THOMAS HOOD

SPANG-CHALFANT

Division of The National Supply Company

GENERAL SALES OFFICE: GRANT BUILDING, PITTSBURGH 30, PA.

District Offices and Sales Representatives in Principal Cities

Electrical Contracting, December 1945

IN THE NEWS

ELECTRICAL MODERNIZATION PACES LEAGUE PROGRAMS

With the groundwork well established by the wartime promotion of Home Planners Institutes, Electrical Leagues throughout the country are now ready to actively promote "electrical living" to a modernization-minded public. With this as a background, some 45 managers and representatives of Electrical Leagues throughout the U. S. met at Chicago's Hotel Morrison, Nov. 1-3, for the Tenth Annual Meeting of the International Association of Electrical Leagues.

Brief cases bulged with promotional plans about to be launched and with reports of activities already under way. But there was still room for notes to be tucked in and taken back to the home grounds. For it was a round table forum—the type of meeting where ideas are generated, where experiences are exchanged; where nationwide talent put their heads together to devise ways and means to better promote the electrical industry. Highlighting the three-day session were discussions of the merchandising picture, adequate wiring, home wiring modernization and veteran replacement programs.

In the merchandising field we are heading for a boom bigger than that of the late twenties and a bust lower than that of the early thirties, according to George F. Taubeneck, editor and publisher, Business News Publishing Co., Detroit. With 15 million refrigerators going to be sold in the next three years, manufacturers are planning to make 23 million units. He attributed this to the fact that each manufacturer is trying for a bigger take than before the war; trying to smother new competition; and being misled by fallacious market figures from factory men and dealers looking for franchises (customers have signed orders, or honorable intentions with more than one dealer at a time). With new homes and replacements making up 95 percent of the sales, Mr. Taubeneck sees the need for intensive sales training now and a revival of the old time specialty selling. The trade-in problem, is being studied by a NEMA committee and some co-operatives have already set up a central plant with professional appraisers to hand out evaluation figures on specific makes and models—a blue book idea

designed to avoid cut-throat competition, he added.

Television and FM

The future of television was outlined by Seymour Mintz, advertising director, Admiral Corporation, Chicago, who predicted that it would be a major industry within three to five years. Reasons: The present 20 to 25 mile transmission limit will be extended through the use of automatic relay stations and coaxial cable; the Bell Telephone System is planning to install 7,000 miles of coaxial cable and will, if requested, provide additional conductors for television; applications for 90 or more television stations are now before the F.C.C. (nine stations are now operating). With a possible audience of 22 million people and only 7,000 television sets now in use, he foresees a mass market, although not in the immediate future. Television will complement the radio and phonograph, he added, warning against expecting a combination television-phonograph set in the \$200 bracket. An average television antenna installation costs about \$40, he concluded.

A. H. Brolly, chief engineer, radio station WBKB, Chicago, predicted that it would be a long time before static-free FM replaces conventional AM broadcasting. Because of the limited

transmission range, there must be many more FM than AM stations before this can be accomplished. Some 2000 stations can be put in the 88 to 106 megacycle frequency band allotted to FM, he revealed, and a transmission range of 55 miles can be had with a 500-ft. high transmitting antenna and a 30-ft. high receiving antenna. Higher powered stations will reach 70 mile transmission. The logical men to train for servicing both FM and television sets are the radar-trained returning veterans who have been dealing with high frequency equipment, he concluded.

Adequate Wiring

There will be a host of unhappy and disappointed purchasers of postwar appliances unless they have adequately wired homes in which to use them. Hand in hand with appliance sales promotion goes promotion of adequate wiring and home wiring modernization. The National Adequate Wiring Bureau is again setting up its Certification machinery, stated E. S. Northup of the NAWB, New York City. The 1946 program will be divided into three distinct categories: New home; old home; and general promotion. Presentation folders on the subject will be sent to builders, utilities, contractors and home financing institutions. A new set of



"He's got fourteen daughters and wants us to fix these door chimes so they'll play the wedding march."

Cut your soldering costs 50% with



Insto-gas
TORCHES & FURNACES

6 SIZES OF TORCHES

The Universal Portable Heat

ALL TYPES OF WORK

Instant-lighting Torches for lead welding, all types of soldering, paint removing, thawing, pre-heating, etc.

NON-OXIDIZING

Insto-Gas produces an absolutely clean non-oxidizing flame, leaves no smoke, soot, or grease deposits to cause a faulty soldered joint.

ECONOMICAL

A cylinder of Insto-Gas lasts at least five times as long as a cylinder of compressed gas of approximately the same weight . . . Economy!

QUICK!

Insto-Gas produces its own pressure, lights instantly, won't blow out.

NO SOOT OR GREASE

Insto-Gas non-oxidizing flame makes perfect copper pipe soldered joints and leaves no soot or grease to be cleaned from the fitting.

SAFE PORTABLE HEAT

Insto-Gas AND equipment are recognized as the safest portable heat, listed by both Underwriters and Factory Mutuals Laboratories.

WHOLESALE CANNOT SUPPLY INSTO-GAS. MAIL COUNCIL
INSTO-GAS CORPORATION—DETROIT 7, MICH.
Please send Insto-Gas Bulletin and name of nearest Distributor.



Name.....

Address.....

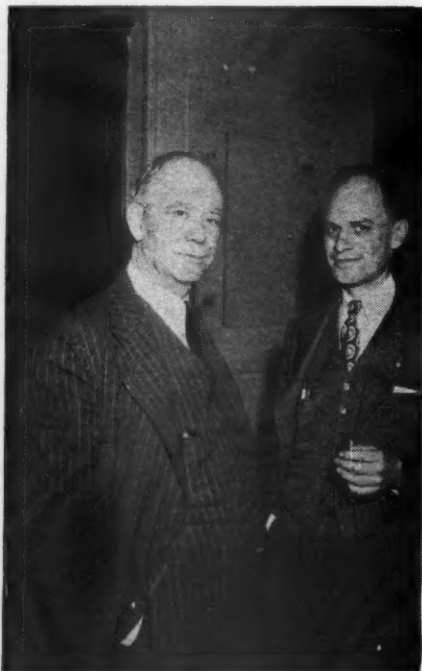
E. C.

INSTO-GAS CORPORATION, 1900 East Jefferson Ave. DETROIT 7, MICH.

National Standards set up by the Industry Committee will be available; a revised "Check-Your-Wiring" folder and a new Plan Book telling the adequate wiring certification story and home modernization plan is in the making as well as new advertising plans. A plastic template with die cuts of standard electrical symbols is also available for architects, engineers, builders and contractors, Mr. Northup revealed.

Prefabricated home builders will recommend adequate wiring in their units, stated Mr. Northup. Only 8 or 10 plants will really go into heavy production, he added. Three distinct methods of building the units are indicated: The Kaiser plan is to prefabricate on the job site; Prefabrication Engineering Company's units will be built in sections and bolted together at the site; Gunnison Homes will be prefabricated in panels and erected at the job. PrecisionBuilt Homes in Trenton, N. J., chose an electrical dealer (who grew into a small department store during the war) as its representative, it was revealed.

Out in California, the NAWB program will tie-in with the Red Seal plan which has been in operation for a number of years. Home buyers out there are demanding an AW certificate as a condition of the sale. Up in Toronto, Canada, adequate wiring, in the form of the Red Seal plan, has been in effect for 22 years with 33,000 homes (90 percent of all in that area) certified. The Toronto League, according



Swapping ideas on veterans replacement program at IAEL conference in Chicago are A. A. Gray (left), Electric Association of Chicago; and S. E. Strunk, Electric League of Cleveland.



A. H. Brolly, chief engineer, television radio station WBKB, Chicago, tells electrical league managers of television's future at recent IAEL conference in Chicago.

to George W. Austen, will expand into an Ontario (province) organization and will carry the plan throughout the province. All Leagues are planning to promote adequate wiring in one form or another.

Wiring Modernization

Home Modernization programs to reach the already wired homes are another League activity. Many are working directly with loaning agencies and financial institutions. Considerable success was reported by J. A. Morrison of Philadelphia where the Electric Association interested banks in the promotional program. Since loans to individuals are the only ones bearing a 6 percent return, banks are cooperating with this plan, dividing the promotional cost evenly with the Institute. So far 38 banks have distributed over 600,000 folders to their customers telling them the story of modernized wiring and how to finance it. Data on the results obtained is now being compiled.

In California, a Business Planning Institute—which goes beyond the scope of the Home Planners Institutes and takes in the commercial phase—is being sponsored by the State Department of Education with the electrical associations tying-in, reported V. C. Hartley, IAEL president. Discussions include store and commercial building modernization and related subjects. Two full-time men are promoting the program. Electrical contractors are actively supporting this plan which promises to bring them considerable business.

Following the thought of electrical modernization in the lighting field, W. H. Robinson, Jr., Manager, Adver-

CROUSE-HINDS

Plugs and Receptacles

The illustrations show a representative selection from the hundreds of different electrical plugs and receptacles that are listed in Crouse-Hinds CONDULET Catalog No. 2500. A full range of sizes — 10 amperes to 400 amperes, up to 600 volts A. C.

No. 5

of a series of advertisements which demonstrate that CROUSE-HINDS "complete line" means much more than just a range of sizes — there is a wide variety of highly specialized types in each classification.



Type C Condulet with Double T Slot Receptacle



Type C Condulet with Receptacle



Type DXE Condulet with Twist Lock Receptacle



Type FS Condulet with Pilot Light, Switch and Receptacle



Type FS Two-gang Tandem Condulet with Switch and Receptacle



Type FSC Condulet with Type BRD Receptacle and Plug



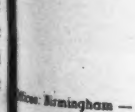
Type BHM Receptacle Condulet for Flush Mounting with Plug



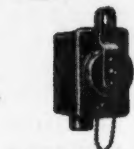
Type BRME Receptacle Condulet



Type BR Extension Cable Connector Double Receptacle



Type BRC Extension Cable Connector Receptacle and Plug



Type FS Weatherproof Receptacle Condulet with Locking Cover



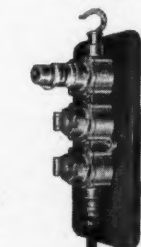
Type FSC Receptacle Condulet with Three Receptacles and a Watertight Plug



Type FS Condulet with Type FAR Arktype Receptacle



Type PRB Receptacle Condulet with Five Receptacles



Type GSP Portable Receptacles with Plug Three-Gang



Type BR Extension Cable Connector Double Receptacle



Type BRC Extension Cable Connector Receptacle and Plug



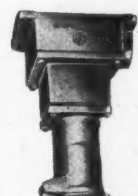
Type ARE Arktype Receptacle



Type ARRC Condulet with Arktype Receptacle



Type ARD Condulet with Arktype Receptacle



Type AJ Condulet with Arktype Receptacle



Type GST Condulet with Type BRG Receptacle and Plug



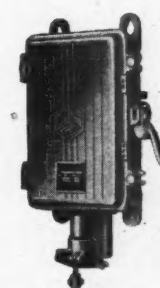
Type APC Arktype Extension Cable Connector



Type AEQ Arktype Receptacle for Flush Mounting



Type BRW Watertight Double Receptacle Condulet with Plug for Railroad Yards



Type WMKS Interlocking Safety Switch and Receptacle



Type AREX Arktype Receptacle



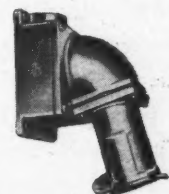
Type APF Fusible Arktype Plug, Exploded View



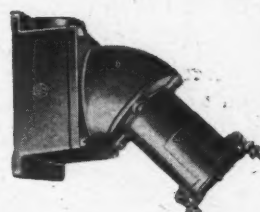
Adjustable Type EHS Explosion-Proof Delayed Action Receptacle Condulet



Type AEQ Arktype Receptacle for Flush Mounting, Two-gang



Type AREA Arktype Receptacle



Type AREA Arktype Receptacle



Type FSQ Explosion-Proof Interlocking Receptacle and Switch



Type CES Explosion-Proof Delayed Action Arktype Receptacle



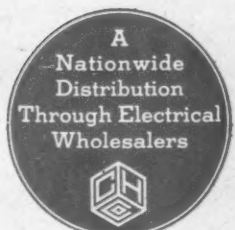
Type CPS Explosion-Proof Delayed Action Arktype Receptacle with Plug



Type CPS Explosion-Proof Delayed Action Arktype Receptacles, Two-gang



Type FSQC Explosion-Proof Interlocking Receptacle and Switch



CROUSE-HINDS COMPANY
Syracuse 1, N. Y., U.S.A.

Birmingham — Boston — Buffalo — Chicago — Cincinnati — Cleveland — Dallas — Denver — Detroit — Houston — Kansas City — Los Angeles — Milwaukee — Minneapolis — New York — Philadelphia — Pittsburgh — San Francisco — Seattle — St. Louis — Washington. Resident Product Engineers: Albany — Atlanta — Charlotte — CROUSE-HINDS COMPANY OF CANADA, LTD., Main Office and Plant: TORONTO, ONT.

CONDULETS • TRAFFIC SIGNALS • AIRPORT LIGHTING • FLOODLIGHTS

REMEMBER Jerry?



• He's the chap responsible for all those Jerry-built lighting fixtures that broke out like a rash o'hives these past few hectic years.

Worst of all Jerry is still around, making the same dubious kind of lighting equipment . . . and still "hooking" certain unsuspecting buyers. SILV-A-KING products, on the other hand, are honest, through and through. They're made of dependable, seamless heavy gauge steel . . . drawn in one piece. Their efficient lifetime reflectivity is the result of a porcelain enamel finish typically SILV-A-KING!

You'll find it good practice to specify SILV-A-KING Products now, and for years and years to come.

SILV-A-KING "SPECIFICATION"

Lifetime porcelain
fluorescent unit

OPEN-END UNIT



CLOSED-END UNIT

RLM



BULLETIN 45 FS—YOURS FOR THE ASKING!

BRIGHT LIGHT REFLECTOR CO. INC.
Fairfield and State • Bridgeport 5, Conn.

SILV-A-KING
LIGHTING EQUIPMENT
SINCE 1929

tising Division, General Electric Lamp Division, Nela Park, Cleveland, outlined an extensive promotional and lighting sales training plan that his company is launching. Kitchen lighting is a good market in the home field and store lighting in the commercial field, he added, urging that a program be initiated to prevent "under arm" selling of fluorescent units. Contractors can do a real job, he asserted, since they install the units.

W. A. Ritt revealed that the Minneapolis group is furnishing commercial lighting advertising in conjunction with the contractors to forestall "fixture peddler" activities. Contractors guarantee a six-month free-service including lamp renewals on all work they sell and install. So far the plan has been highly successful.

E.M.E. Activities

Open discussion of Electrical Maintenance Engineers activities revealed that there are 17 such groups in major U. S. cities acting as liaison between the manufacturers and plant electrical departments. Some are an integral part of the electrical league; others are operated as separate programs.

In St. Louis, Carl Christine reports the successful operation of a top group of about 30 key electrical plant engineers who meet separately to discuss the more theoretical problems while the main group covers the less technical and more practical aspects of plant electrical maintenance.

In Cleveland, according to S. E. Strunk, the E.M.E.'s are a separate group with their own officers and by-laws. Membership includes 500 industrial plant and 100 commercial building maintenance men.

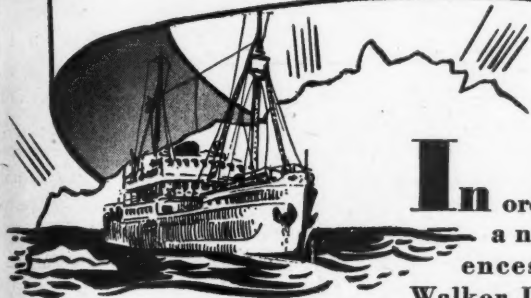


East coast Leaguers at recent IAEI conference in Chicago were E. E. Samson (left), Electric Institute of Washington, D. C.; and J. G. Waddell, Electric Institute of Boston, Inc.

DUALCOTE

stands the gaff

Eighty thousand miles...
eighteen months at sea



In order to learn what
a new set of experi-
ences could do to
Walker DUALCOTE, a

section of this highly resistant conduit was strapped
to the deck of a vessel sailing for one of the Polar
seas. It resulted in one of the most rigorous tests
to which a conduit was ever subjected.

Deluged by rain and deck-washing seas, encrusted
with salts, broiled by an Equatorial sun, and frozen
in ice... for 18 months the DUALCOTE section
withstood every sort of punishment Nature could
inflict. And the result: when the salt deposit
was removed, the DUALCOTE finish was still
intact.

DUALCOTE Conduit is doubly protected.
First, by a coating of zinc, which is fused into
the inside and outside walls of the conduit;
second, by an outer coating, a new material,
which prevents salt water, acids and caustics
from eroding the underlying protection.

For full particulars regarding Walker
DUALCOTE, write to Walker Brothers,
Conshohocken, Pa.

DRENCHED by
RAIN and SEA

CRUSTED
with SALT

BURNED by
TROPIC SUN

FROZEN in
POLAR ICE

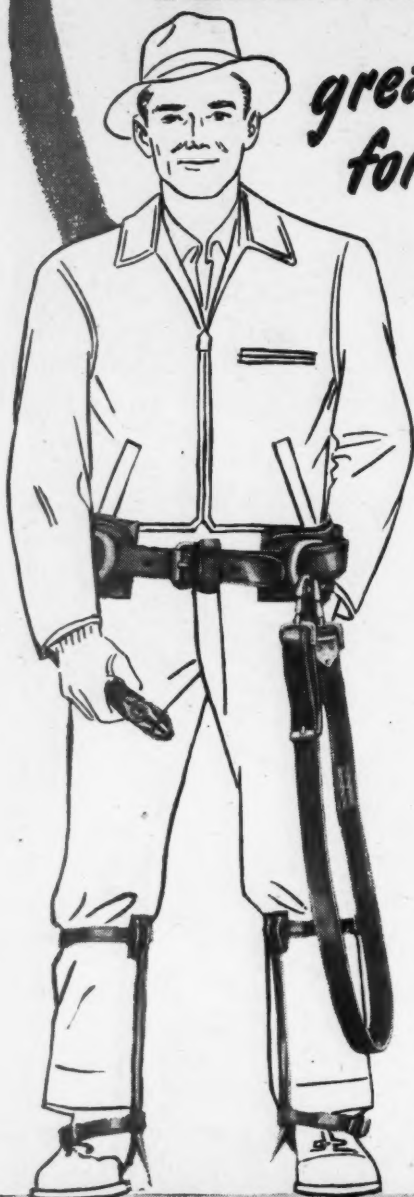
WIRE WITH
WALKER

WALKER & Conshohocken

Makers of Rubber-covered, Synthetic and Lead-coated Wires and Cables • "Walkerflex" Non-metallic Sheathed Cables • Service
Entrance Cables • Automotive Wires and Cables • Shipboard Cables—Lead-coated, Non-Lead-coated, Synthetic or Varnished Cambric
Insulation • Electric Metallic Tubing • "Dualcote" Rigid Steel Conduit • "Frost-Invert" Underfloor Distribution Systems

KLEIN-KORD..

greater safety for LINEMEN!



Klein-Kord Safety Straps, developed more than ten years ago, are today used exclusively by many of the country's largest public utilities.

Multiple plies of long staple cotton of a special weave are vulcanized in rubber. This weave permits the use of a tongue-type buckle without risk of slipping or ripping, even under severe tension and excessive loads. The red center provides a warning signal. The strap is safe for use until worn down to the center ply—"Stop when you see red."

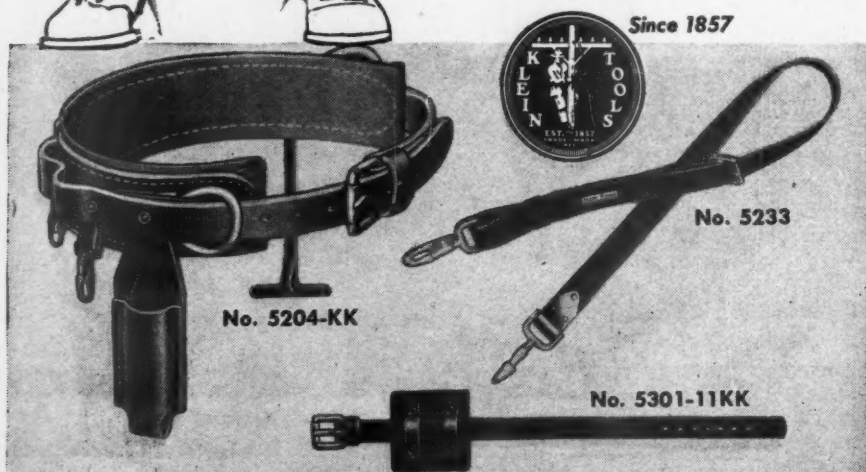
Klein-Kord is extremely tough, flexible, and of uniform thickness and strength. It has a low conductivity, will not stretch, and is unaffected by moisture.

An improved Tool Belt of Klein-Kord is also available. This belt has found favor with linemen, and offers the quality features that have made Klein Belts the choice of linemen for generations.

Klein-Kord is an exclusive Klein development available only on equipment carrying the Klein trade-mark.

Write for book giving full information on Klein-Kord Safety Straps and Belts.

Foreign Distributor:
International Standard Electric Corp., New York



Mathias KLEIN & Sons
Established 1857 Chicago, Ill., U.S.A.

3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS



East and West League managers at IAEI's annual conference in Chicago are (L to R) W. P. Robinson, Passaic County Electrical League, Passaic, N. J.; Jack Smalley, Electrical League of Western Pennsylvania, Pittsburgh; and Ralph B. Hubbard, Rocky Mountain Electrical League, Denver, Colorado.

From the standpoint of service and repair training, Sheridan Taylor of Philadelphia, recounted details of a cooperative program with the universities and vocational schools in that city. The educational institutions offer gratis the teaching talent and laboratory facilities; the association; the trainees. In addition to elementary courses in the theory and application of electricity, they have been operating refrigeration and oil burner service schools for the past three years and the waiting list is still over 200. Cost is covered by a small entrance fee. Similar schools in other service fields were reported in operation by league representatives.

There are acres of diamonds in the industrial and commercial electrical field, if only we seek them out, asserted V. C. Hartley, Los Angeles, while outlining an illustrated lecture he is using on the Pacific coast beamed at maintenance electricians and contractors. Investigate the industrial and commercial establishments in your community, find where and how they can utilize electricity and familiarize yourself with the latest equipment developments and applications, he urged.

In this same vein, St. Louis is planning a program to survey industrial plans with a team of specialists—one on lighting; power factor; construction, safety, etc.—to determine what is necessary to bring the electrical system up to an efficient standard.

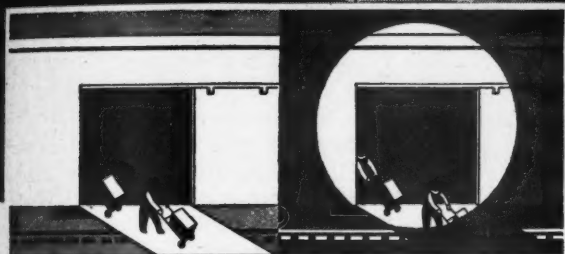
Veteran Re-employment

To date, little success has been met with employment of veterans in this specific electrical field—primarily due to the lack of qualifications and inefficient screening of applicants, and the apparent disinterest of veterans to work at the salaries offered by industry.

Discussing the Veterans Re-employ-

BOOST THE FIGURES FOR OUTDOOR WORK

WITH Engineered Floodlighting



To bring hourly production at night nearer to daytime figures, look to your outdoor illumination—to floodlighting by Westinghouse.

Freight terminals require lighting intensities relatively higher than most outdoor applications, to permit reading of numbers and markings on crates. Special care must be taken to avoid shadows.

LET WESTINGHOUSE FLOODLIGHTS
SPEED YOUR PRODUCTION



IN number of cars loaded . . . materials moved . . . stock piled . . . the volume of work depends on illumination. And Westinghouse lighting engineers, the pioneers in outdoor illumination, now offer the most modern methods and equipment for this type of lighting.

Floodlights in open or enclosed weatherproof designs are available for use with 100 to 2000-watt lamps.

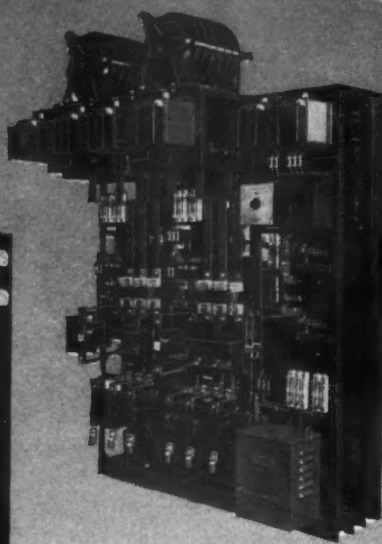
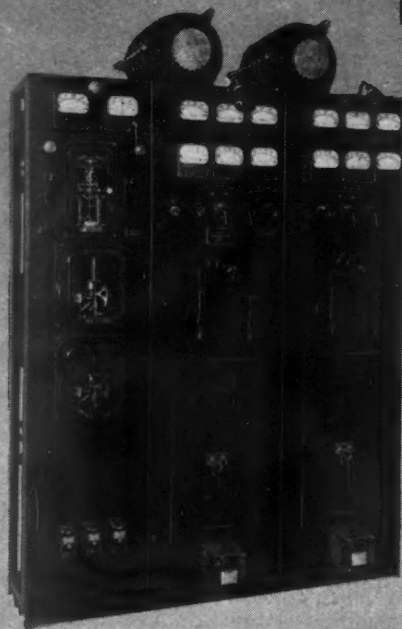
The methods that originated with Westinghouse lighting engineers have proved highly efficient in furnishing light for outdoor work, for protection against peacetime intruders and for barriers against saboteurs. All this outdoor lighting equipment and the engineering experience needed to plan it, is available through Westinghouse Electric Supply Company offices and independent lighting distributors. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-04019

Westinghouse *Lighting* **EQUIPMENT**
AVAILABLE THROUGH 117 WESTINGHOUSE ELECTRIC SUPPLY COMPANY OFFICES AND INDEPENDENT DISTRIBUTORS

For PROMPT and DEPENDABLE Design, Construction and Delivery

Below: Front view of dead-front main switchboard for oil tankers.



Above: The rear view of this Pelham-designed switchboard shows the compactness, and the concealed wiring in steel channels.

of Any Type of SWITCHBOARD

TRY PELHAM FOR YOUR SWITCHBOARDS:

No matter how difficult the design problems may be, our engineers have probably solved them . . . Wide experience in designing every kind of switchboard and special panelboard . . . Built to the highest quality standards . . . And—you can depend on our deliveries.

PELHAM ELECTRIC MANUFACTURING CORP., Erie, Penna.

SPECIALIZED
DESIGN

Pelham

UNEXCELLED
QUALITY

• SWITCH BOARDS • PANEL BOARDS • SWITCH GEAR AND ACCESSORIES

ment Program of the National Electrical Wholesalers Association, R. C. Hill, manager of the group, urged development of local industry cooperation; stimulation of veteran interest in the electrical industry; arrangement for distribution of applicants for employment throughout the entire electrical industry; free exchange of all data and information about veterans; and training programs. Mr. Hill revealed a 150,000 man market at retailers level and that NEWA and EEI are sponsoring a \$130,000 basic sales training program to secure the needed personnel.

An insight into the veteran reemployment situation in some of the cities represented follows:

Cleveland—1000 jobs open in the electrical industry. The league prepared a special book on electrical industry opportunities given to Veterans hospitals for ward discussions. No definite results as yet were reported.

New York—Program in effect for 3½ months. Of 100 veterans screened, only 7 have been employed—not one had any sales experience. Vets seem in no hurry to settle down. Local employment agencies are kept posted.

Washington, D. C.—Draft board working with League in hiring vets. Of 300 men per week interviewed, only 10 percent are interested. Of the first 35 to come only 3 went to work.

Charleston, W. Va.—Chamber of Commerce does the screening with the electrical association cooperating. Program just under way.

Tennessee—Of 60,000 men Hamilton County sent into armed forces, 13,000 now returned—all workers before war.

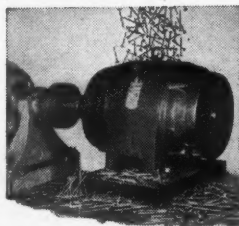


Elias J. Strong, manager, Intermountain Electrical Association of Salt Lake City, Utah, emphasizes a few points to J. Clark Chamberlain, Bureau of Radio and Electrical Appliances, San Diego, Calif., at recent IAEI conference in Chicago.



PROTECTED
from dropping liquids
and particles

Protectioneered—that's the word for the new Fairbanks-Morse general-purpose motor. It incorporates protection for the operator as well as for the motor.



The protected frame and the position of the air vents in the bearing brackets keep out flying chips, falling particles, and dripping liquids. There are no exposed moving parts to catch fingers or clothing. Smooth external surfaces make the motor easy to keep clean.

This, plus other advanced features, assures outstanding performance, dependability, and versatility. See the new motor demonstrated to appreciate what it can do for you. Write Fairbanks, Morse & Co., Fairbanks-Morse Building, Chicago 5, Ill.

Every Good Feature You Could Ask!

Copperspun Rotor—The *only* rotor centrifugally cast in one piece—and of *copper*.

Cross-flow Ventilation—Another exclusive feature. Air moves in both directions, providing uniform cooling—no hot spots.

Ball Bearings—Sealed in and protected.

Recessed Conduit Box—An innovation for neat installations in close quarters. Conventional box also provided.

Adaptability—Frame gives protection in any mounting position because the vented bearing brackets can be turned to four positions 90° apart. Reversible frame permits locating conduit box on either side.

Balanced Characteristics—A 40° C. motor with high efficiency and power factor, and excellent starting and accelerating torques.

BUY VICTORY BONDS

Fairbanks-Morse

A name worth remembering



Diesel Locomotives • Diesel Engines • Generators • Motors • Pumps • Scales
Magnetos • Stokers • Railroad Motor Cars and Standpipes • Farm Equipment



Call

 for
FLOODLIGHTS

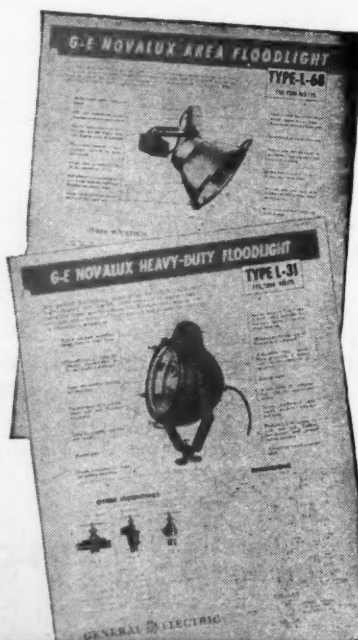
...and get these important advantages

- ★ Proper types and sizes for all applications
- ★ High-efficiency, the result of scientific design
- ★ Long life and low maintenance expense, obtained through sturdy construction
- ★ Expert assistance with application problems, backed up by 30 years' experience
- ★ Convenient sales and service facilities

WANT THESE HANDY DESCRIPTIVE LEAFLETS FOR YOUR PROPOSALS?

FLOODLIGHT	PUBLICATION
Heavy-duty, steel casing 200 or 250 watts, Type L-29 300 or 500 watts, Type L-30 750 or 1000 watts, Type L-31	GEA-4303 GEA-4304 GEA-4305
Heavy-duty, cast aluminum 200 or 250 watts, Type L-38	GEA-4325
General purpose, sheet aluminum 300 or 500 watts, Type L-49 750 or 1000 watts, Type L-43	GEA-4311 GEA-4310
Sports and area, sheet aluminum 750 to 1500 watts, Type L-68	GEA-4333
Area, open porcelain enamel 300 to 1500 watts (Type L-45) (Type L-46)	GEA-2877B
Handy, sheet aluminum 200 watts, Type L-66	GEA-4346

Order individually by number, or in sets, from the G-E Apparatus Sales Office or Agent that serves you. Or write General Electric Company, Schenectady 5, N. Y.



GENERAL  ELECTRIC

and only 14 percent have taken jobs. An estimated 13 percent are disabled. Draft boards in and around Cincinnati are working with League in replacement program.

New Orleans—Utility sales department needs 60 men alone. Of 200 men per week applying during past month only 48 survived screening; only eight were hired. Of first 200 to come in only one was hired. Veterans Administration must be sold the necessity of screening out men not suitable to the industry.

Minneapolis—During October, 39 openings in the industry—39 of them journeymen electricians. There were 14 veterans placed during this time.

League managers were given an insight into sales training by Norway Craighead, merchandise service manager, Bendix Home Appliances, Inc., who outlined the comprehensive sales training program his company uses. Salesmen must be given a decent compensation—a reasonable salary plus commissions—he asserted, pointing out that the dealer should make an investment in a man if he expects to get a good return in the way of increased sales.

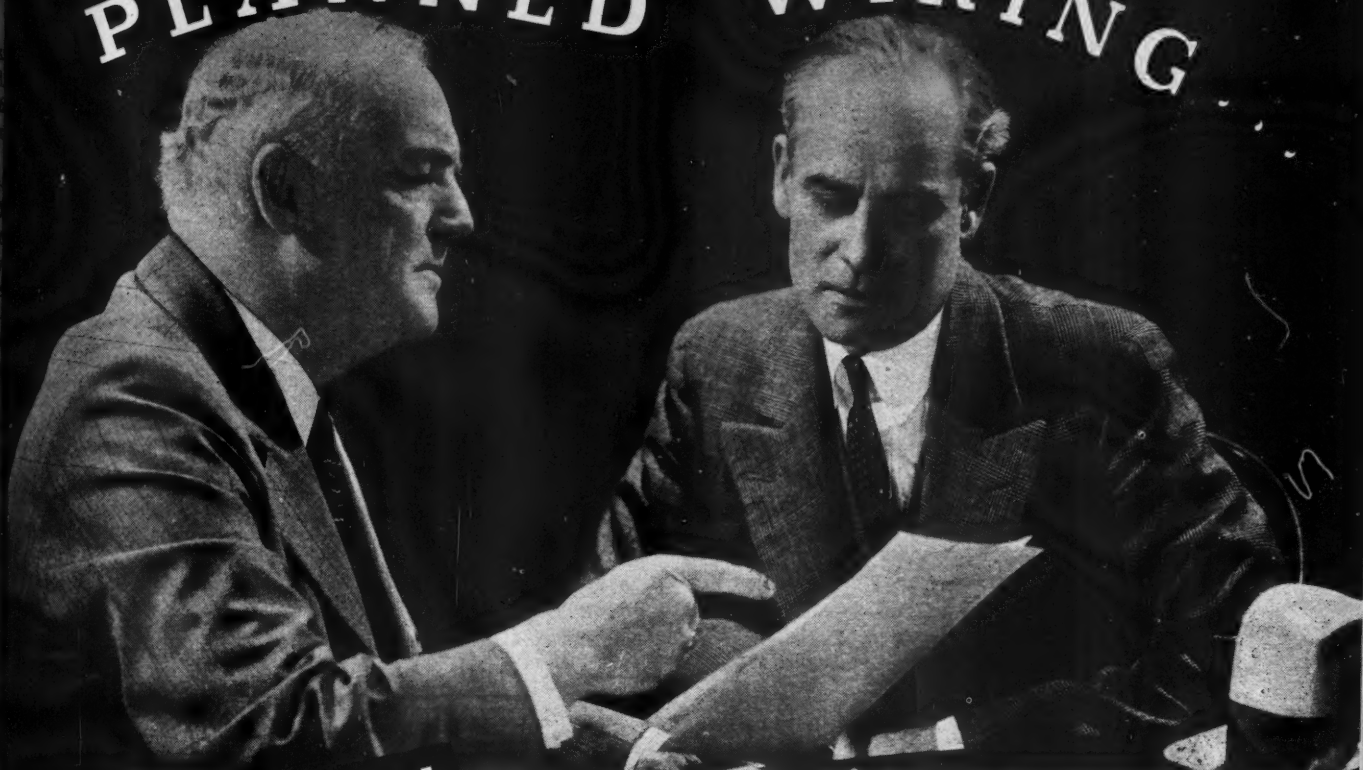
At the final business session the following league representatives were elected to international office: President—V. W. Hartley, managing director, Pacific Coast Electrical Association, Los Angeles, Calif.; vice president—W. G. Hills, manager, Electric Institute of Washington, D. C.; treasurer—J. A. Morrison, managing director, Electrical Association of Philadelphia; secretary—O. C. Small, manager, business development dept., NEMA, New York City. Directors elected included: W. A. Ritt, Minneapolis; J. A. Morrison, Philadelphia; C. H. Christensen, St. Louis; V. W. Hartley, Los Angeles; W. G. Hills, Washington, D. C.; S. E. Strunk, Cleveland; H. F. Bennett, Kansas City, Mo.; J. C. Chamberlain, San Diego; and G. W. Austin, Toronto, Canada.

EASTERN INSPECTORS HOLD ANNUAL MEETING

The Eastern Section, International Association of Electrical Inspectors held its Twenty-First Annual Meeting October 22-24 at the Hotel New Yorker, New York City. Main topic of discussion at this meeting was changes which will be made in the new 1946 National Electrical Code. These discussions were widely participated in by the more than 175 members and guests who attended the session.

G. S. Casterline, President of the Eastern Section, was presiding officer.

PLANNED WIRING



PORCELAIN PROTECTED WIRING SYSTEMS

WHEN YOU PLAN FOR ADEQUACY **INSURE**

COMPLETE INSULATION AND PROTECTION FROM THE ENTRANCE
SWITCH TO THE LAST OUTLET ON THE SYSTEM

The use of PORCELAIN PROTECTED WIRING SYSTEMS in today's new home construction and modernization of existing homes gives contractors the means for doing jobs that are (1) ADEQUATE; (2) SAFE; (3) PERMANENT; (4) MODERN; (5) ECONOMICAL.

All of these 5 points are highly important to your customers and when you can produce all of them, on each job, you build your prestige as well as your profit.

Porcelain manufacturers have developed each device that goes to make a complete system, for greatest wiring convenience, for good appearance, and for outstanding serviceability.

Now is the time to get fully acquainted with PORCELAIN and its exceptional advantages to you and to your customers.

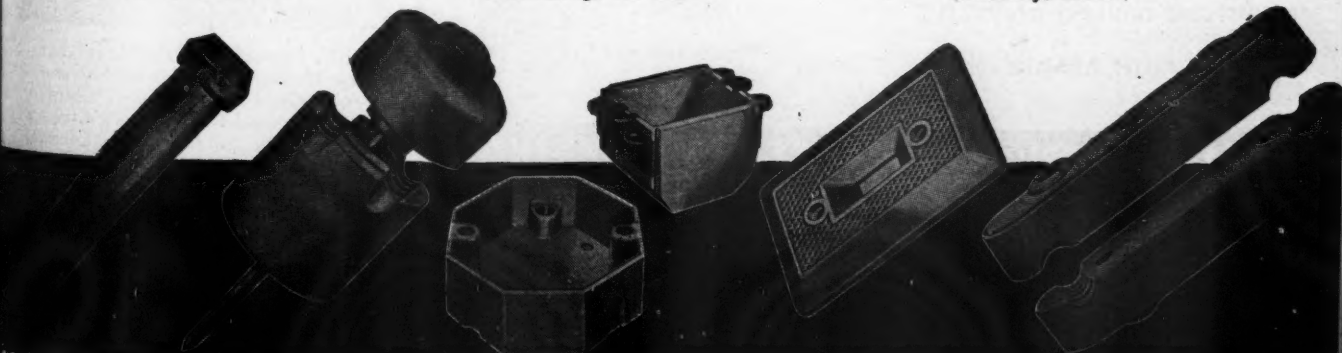
★ ILLINOIS ELECTRIC PORCELAIN CO.
Macomb, Ill.

★ PORCELAIN PRODUCTS, INCORPORATED
Findlay, Ohio

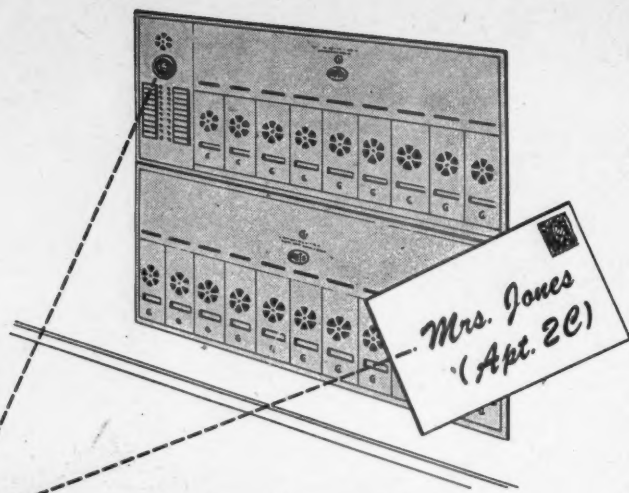
★ SPECIALTY PORCELAIN WORKS
East Liverpool, Ohio

★ SUPERIOR PORCELAIN COMPANY
Parkersburg, W. Va.

★ UNIVERSAL CLAY PRODUCTS COMPANY
Sandusky, Ohio



MODERN PORCELAIN PROTECTED WIRING SYSTEMS



Mrs. Jones (Apt. 2C)

RELIES ON AUTH 3000 TIMES A YEAR!

Mail several times daily from the Auth apartment mail box—several visitors putting the Auth chimes and door-opener to work, sometimes using the lobby phone—Auth bells morning and evening for the service elevator—occasionally a call to the superintendent or doorman. Yes, Mrs. Jones and all her neighbors make amazingly hard use of Auth equipment.

For just this kind of severe service, Auth has been designing and making superior signaling devices since 1892, and now is the leader in the apartment systems field. Every detail of Auth equipment means service for modern living, longer electrical life, greater mechanical strength, and easier installation with lasting beauty in both tone and appearance.

YOU, TOO, CAN RELY ON AUTH—

As a result of Auth's rigid factory inspection and Auth's guarantee, you'll have no trouble with complaints due to equipment failure. And you can rely on the Auth catalog, for in it you'll find every signaling device you need for apartments and housing projects.

ASK FOR AUTH APARTMENT BULLETIN 95



All types of apartment telephone systems

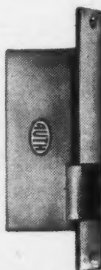
Auth Flushchimes, with amazing tonal beauty. Also manually operated door chimes



Complete line of bells and buzzers, including compact, flush-mounting types



Push buttons and door releases



1-R

AUTH ELECTRICAL SPECIALTY COMPANY, INC.

422 EAST 53rd STREET

NEW YORK 22, N. Y.

Offices in



Principal Cities

SINCE 1892

of the convention's first and third day sessions. P. J. Hicks, Jr., First Vice-President, presided over the second day's session.

L. P. Dendel, Lansing, Michigan, president of IAEI, in addressing the group stressed the duties of the members in serving the public and the importance of electrical inspection at this time. Substitute materials have been permitted during the war, he said. There will be increased wiring work in the months and years ahead, and many new wiremen will appear on the scene to assist in the vast electrical program. There is need for much educational work by electrical inspectors among these newcomers to the field, and in connection with the new Code, he stated.

Secretary-treasurer Victor H. Tousley, Chicago, discussed the advantages of membership in IAEI, the need for getting other inspectors into the Association, and for studying the new Code, revised for the first time in six years.

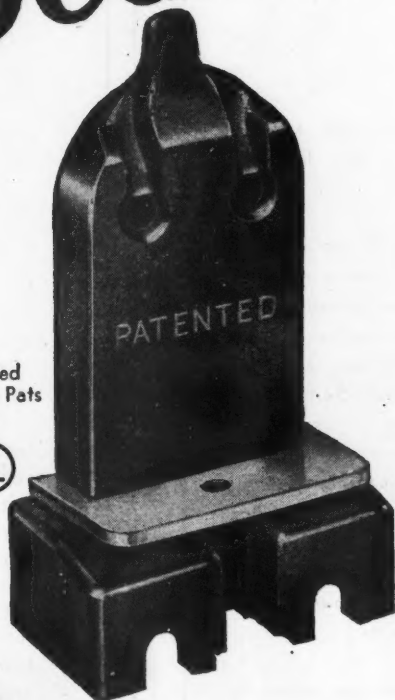
J. D. Lynett, Chairman of the Fire and Accident Committee, reported that many members of the large committee failed to turn in reports, making it impossible to give a complete committee report at this time. Fires in New York City for the year 1945 are estimated at 4500, with 150 fires due to defective electric fixtures alone, he said. Electrical fires are still in high second place nationally, he reported, where one



IAEI's President L. P. Dendel, Lansing, Mich., (right) and Secretary-Treasurer V. H. Tousley, Chicago, were on hand in New York City for the Eastern Section's 21st Annual meeting, October 22-24. Secretary Tousley discussed advantages of membership in IAEI and need for increasing membership, while President Dendel stressed the importance of electrical inspection in postwar electrical installations.

Unbeatables

Patented
Other Pats
Pend.



Pat. Nos.
2200443
2228210



Lloyd { Flex-Loc lampholder Automatic Starter

FLEX-LOC Lamp Holder

FLEXIBLE — Automatic — self-adjusting to variations in lengths of lamps or spacing of mounting holes. Engineered to fit all standard spacings.

AUTOMATIC LOCK is positive. No need for extra locking devices. Lamp cannot fall out. Contacts cannot loosen.

EASY insertion and removal. No twisting. No turning. No fussing to seat lamp in holder. FLEX-LOC does the work automatically. As lamp pins slide up to terminal holes, holder is flexed outward. As pins enter holes, holder snaps inward, internal spring returning to normal.

PERFECT ELECTRICAL CONTACT — Newly designed, patented terminals grip BOTH sides of lamp pins . . . make sure and positive contact.

Listed and Approved by
Underwriters' Laboratories Inc.

Lloyd Policy Insures Quality

LLOYD PRODUCTS CO.

Providence 5, R. I.

Branch Offices and Warehouses in 27 Leading Cities

Automatic Starter

Positively cuts out deactivated, flickering, blinking lamps. When trouble is detected the starter automatically cuts off current to the ballast and lamp.

Gives long life to ballast because defective lamp is locked out. Prevents overheating.

When Lloyd AUTOMATIC locks out defective lamp—turn off the current—remove defective lamp—put in a new lamp. Allow at least one minute to make above changes. Turn on current. The starter automatically lights the new lamp. The life of the AUTOMATIC starter is many times greater than that of the average lamp.

It saves maintenance costs and power consumption, protects and insures longer life to ballast and lamp.

Certified by
Electrical Testing Lab., Spec. 6

WHAT MAKES A MAILING CLICK?

Advertising men agree — the list is more than half the story.

McGraw-Hill Mailing Lists, used by leading manufacturers and industrial service organizations, direct your advertising and sales promotional efforts to key purchasing power. They offer thorough horizontal and vertical coverage of major markets, including new personnel and plants. Selections may be made to fit your own special requirements.

New names are added to every McGraw-Hill list daily. List revisions are made on a twenty-four hour basis. And all names are guaranteed accurate within two per cent.



Mc GRAW-HILL
DIRECT MAIL LIST SERVICE

In view of present day difficulties in maintaining your own mailing lists, this efficient personalized service is particularly important in securing the comprehensive market coverage you need and want. Ask for more detailed information today. You'll probably be surprised at the low over-all cost and the tested effectiveness of these hand-picked selections.

DIRECT MAIL DIVISION
McGraw-Hill Publishing Company, Inc.
330 WEST 42nd ST. NEW YORK, N.Y.

home is destroyed by fire every 90 seconds. Fire losses amount to \$4 per capita in the U. S., against \$1 per capita in Britain, and \$.50 per capita in Germany, he declared.

F. N. M. Squires, Secretary, outlined the Section's activities during the past year, in presenting the annual Report of the Secretary. New membership increased by 327, of which 57 were active members, and 290 were associates, he said. Present paid up membership now stands at 1410 members, it was reported.

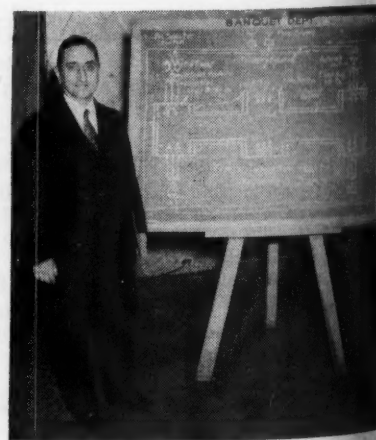
A short annual Report of the Treasurer was made by A. W. Hopkins, Treasurer, in which total receipts and disbursements, and cash on hand, were summarized.

In reporting for the Committee on Maintenance of Electric Wiring and Equipment, W. E. Armstrong, Chairman of this Standing Committee urged broader use of the many good pamphlets available, which would do much to educate the public in the prevention of fires due to faulty wiring and poorly maintained electrical equipment.

C. A. Ward, Chairman of the Post-war Planning Committee, stated no report had been prepared for this Committee, as much of its activities were involved in the issuance of the new Code, which should be ready about November, 1946.

C. F. Meyerherm, Chief Engineer of the American Water Works Association discussed protective grounding, and objected on behalf of his Association, to the use of water pipes for grounding or for current-carrying conductors. More study is needed in connection with the degree of safety afforded, possible effect on water, etc., in using water pipes for grounding, he said, and pointed out that this practice constitutes misuse of private property.

Network systems, in which high



C. P. Xenis, member of the Technical Sub-Committee on Industrial Plant Network Systems, analyzed Network Systems before the Eastern Section IAEE Annual Meeting in New York City, October 22-24.

very 90
\$4 per
per cap-
apita in
outlined
the past
Report
ship in-
re active
ates, he
membership
it was
Treas-
Hopkins,
pts and
d, were
ittee on
ing and
Chair-
e urged
d pam-
to much
vention
d poorly
e Post-
ated no
is Com-
es were
the new
y about
ineer of
Associa-
unding,
Associa-
pes for
ing con-
in con-
fety af-
etc., in
ing, he
practice
property.
h high

It's A
NEW IDEA
IN DOOR
CHIMES

EDWARDS

LADY JANE... A NEW "BEST-SELLER" IN THE POPULAR EDWARDS LINE

Another "new-idea" Door Chime... beautiful, practical Empress Eugenie, serves as a bracket shelf.

• We've really "rung the bell" with the LADY JANE! Not only is it a classic beauty... but it is *practical* as well. Cleverly concealed behind a smartly-styled wall mirror, here is the finest door chime ever presented to the public. More than just fine chimes... designs like the LADY JANE add a decorative note, a "center of interest," to the wall of any entrance hall, living room or library. Designed by internationally-famous Lurelle Guild.

Created in luxurious light ivory on metal, with inlaid French gold striping, this charming mirror-chime is held flush against the wall by means of an "invisible" hook which fits simply and quickly over a nail or screw.

The LADY JANE sounds a gracious two-note melody for the front entrance, and a single note for the rear door. These full tones come from Sonoscope-tested bars, individually resonated. The LADY JANE operates on any good quality doorbell transformer or on a battery. Popularly priced.

EDWARDS AND COMPANY, NORWALK, CONN.

In Canada: Edwards & Co., Ltd.



And there are six other outstanding new Edwards designs! Write today for complete catalogues.

Electrical Contracting, December 1945

BADGER

Synchronous Automatic TIME SWITCHES



**for
ACCURATE
TIMING**

•

**ECONOMICAL
OPERATION**

•

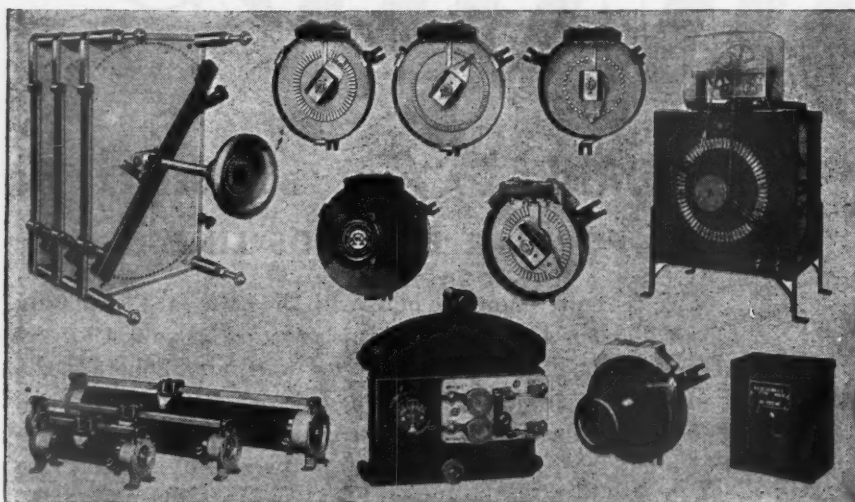
**YEARS OF GOOD
SERVICE**

•

• Prompt delivery without priority

Type	Poles	Switch Capacity	Case
MI (Synchronous)	1	50 A. at 125 V	16 Ga. Steel
M 2	2	50 A. at 125/250 V.	16 Ga. Steel
RM	1	50 A. at 125 V	Cast Iron
RM5	2	50 A. at 125/250 V.	Cast Iron

RELIANCE AUTOMATIC LIGHTING CO. RACINE WISCONSIN



RHEOSTATS

The Ward Leonard line of rheostats includes the widest range of sizes, tapers and current ratings from the tiny types for radio to huge multiple assemblies for the heaviest industrial use. Smooth operation, durable contacts and extreme dependability characterize all Ward Leonard Rheostats, Resistors and Relays. Write for bulletins of interest to you.



WARD LEONARD

RELAYS • RESISTORS • RHEOSTATS

Electric control  devices since 1892.

WARD LEONARD ELECTRIC COMPANY, 28 South St., Mount Vernon, N. Y.

voltages are used for power distribution within a plant or building to load centers, and which will be covered in the 1946 Code, were discussed by C. P. Xenis, of the Consolidated Edison Co. of New York, and R. E. Anthony of Hatzel and Buehler, Inc., electrical contractors, New York City.

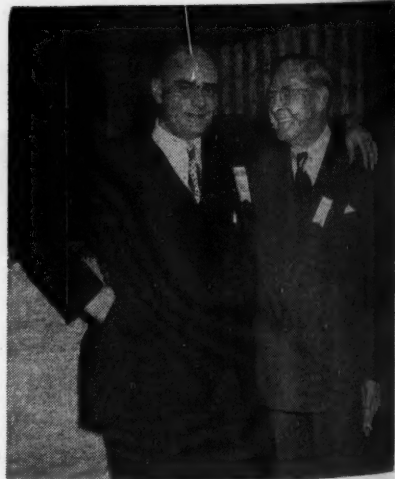
Reports on actions taken by the Electrical Committee, National Fire Prevention Association, at its meeting in Chicago early in October, formed the basis for major discussion throughout the three day session. Among those who made these reports were: R. B. Shepard, M. M. Brandon, C. A. Ward, P. J. Hicks, Jr., M. F. Cody and L. W. McCullough.

V. H. Tousley, Secretary of IAEL, reported that Interim Amendments and interpretations will remain in effect until the new 1946 code becomes effective.

Members discussed at length the problem of grounding of electrical appliances. It was generally agreed that grounding was desirable, and members finally voted to go on record with the Electrical Committee as favoring grounding and recommending that action be taken in the Code which will require it.

M. F. Cody and B. A. McDonald led the early morning code discussions, designed to clarify the code for inspectors, and to permit an interchange of opinions and experiences between members.

A technical discussion of silicones was presented to the conference delegates by J. S. Hurley, Jr., Chemical Department, General Electric Company. He outlined the developments and many applications of this insulating material, and illustrated his talk with charts and samples of products.



E. T. Quinn, Second Vice President, Eastern Section IAEL, and Chief Electrical Inspector, Newark, N. J., relaxes from serious discussions on NEC Article 356, of which he is Code Committee chairman, to chat with H. L. Schaefer, Electrical Inspector, N. Y. Board of Fire Underwriters.

tribution
load cen-
ed in the
y C. P.
ison Co.
thony of
ical con-

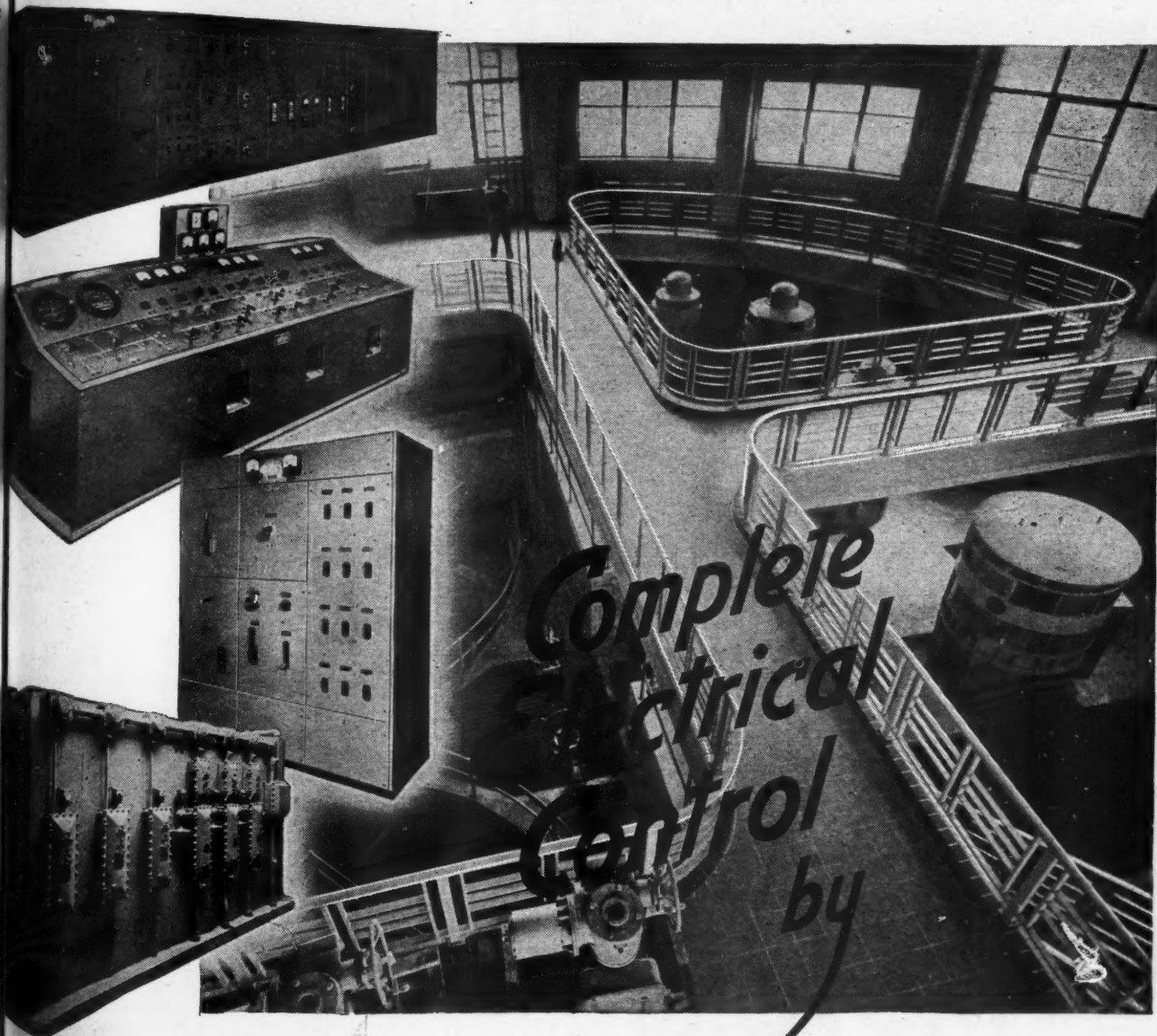
by the
al Fire
meeting
formed
through-
ng those
: R. B.
L. Warl
d L. W.

f IAEI,
ents and
n effect
es effec-

gth the
ical ap-
eed that
members
with the
avoring
that ac-
ch will

hald led
ons, de-
ectors,
f opin-
members.
ilicones
e dela-
chemical
Com-
ments
ulating
k with

FOUR of the 18 METROPOLITAN SWITCHBOARDS IN THE JAMAICA SEWAGE DISPOSAL PLANT



At the right are listed various types of electrical control equipment designed and furnished by METROPOLITAN for utilities, industrial plants, large mercantile establishments, and public buildings. Your inquiries are invited.

- | | |
|---|----------------------------------|
| Knife Switchboards | Motor Control Switchboards |
| Circuit Breaker Switchboards | Explosion-proof Switchboards |
| Dead Front Switchboards | Laboratory and Test Switchboards |
| Battery Charging Switchboards | Control Switchboards |
| Generator and Distribution Switchboards | |



ELECTRIC MANUFACTURING COMPANY

ELECTRIC LIGHTING AND POWER

DISTRIBUTION EQUIPMENT

LONG ISLAND CITY, NEW YORK

**HE SWORE HE WOULDN'T
SHAVE TILL HE FOUND A
ROLL OF GOLD SEAL TAPE
THAT PEELED!**

Small chance of ever finding a roll of Gold Seal Tape that peels . . . dries out . . . smears . . . or ravels. Jenkins lab-tests everything . . . base cloth, compound . . . controls production every step of the way. What is more, Jenkins cellophane wraps—then boxes—every roll to make doubly sure Gold Seal reaches you factory-fresh! Jenkins Bros., Rubber Division, 80 White Street, New York 13, N. Y.



Jenkins Bros. also makes Diamond Seal Friction and Rubber Tapes which meet ASTM and Federal specifications.



JENKINS *Gold Seal Tapes*
FRICTION .. RUBBER

PARTS

FOR

FANS MOTORS CONTROLS

PROMPT SHIPMENT FROM LARGE STOCKS

AUTHORIZED PARTS DISTRIBUTOR

Brown-Brockmeyer
Century
Cutler-Hammer
Delco
Diel
Duro
Emerson

General Electric
Hamilton-Beach
Holtzer-Cabot
Howell
Hunter
Ilg
Leland
Marathon

Master
Peerless
Robbins & Myers
Star
Thor
Wagner
Westinghouse

READING ELECTRIC COMPANY, INC.

Parts Distributors for the Manufacturer

200 William St.

Barclay 7-6616

New York 8, N. Y.

During the final business session, the following officers for the coming year were unanimously elected: President—P. J. Hicks, Jr., Providence, R. I., First Vice-President—E. T. Quinn, Newark, N. J., Second Vice-President—H. H. Daniels, Washington, D. C., Treasurer—A. W. Hopkins, Springfield, Mass., Secretary—F. N. M. Squires, New York, N. Y.

The Executive Committee for the coming year will consist of the Officers and the following: C. A. Berlepsch, Jr., New Haven, Conn.; W. J. Canada, Mountain Lakes, N. J.; J. D. Lynett, New York, N. Y.; W. J. Mahan, New Haven, Conn.; and G. S. Casterline, Syracuse, N. Y.

I.E.S. URGED TO RELIGHT AMERICA

The postwar challenge facing the lighting industry today is one of relighting America to higher quality standards. To meet this, redeployment of research, engineering and commercial forces must be effected. That was the picture presented to illuminating engineers attending the Midwest Regional Conference of the Illuminating Engineering Society, Oct. 31 and Nov. 1, at Davenport, Iowa.

The best engineering skill in the industry will be necessary to meet the mounting requests for information on technical advances demanded by a renewed interest in lighting, declared G. K. Hardacre, Chicago, senior vice-president of I.E.S. Lighting engineers today face a job that cannot be satisfactorily performed with the inadequate training of the past, he warned.



I.E.S. officers at recent Midwestern Regional Conference in Davenport, Iowa, were (L to R) president A. F. Wakefield, Vermilion, Ohio and senior vice-president, G. K. Hardacre, Chicago, Ill.

WIREMOLD

BETTER WIRING
FOR BETTER LIGHTING



THE INSTALLATION

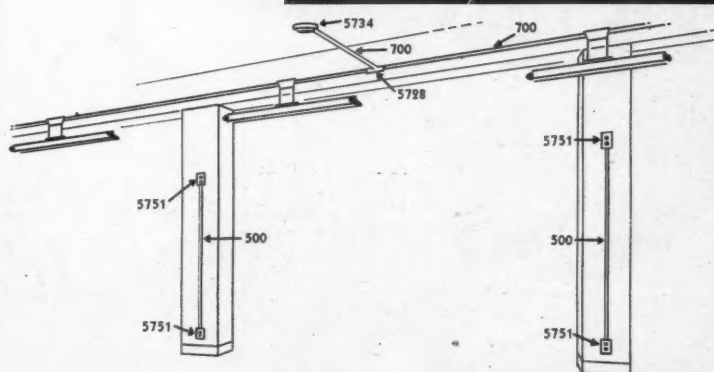
This photograph of a typical modern office floor in a building having loft type construction, shows the use of Wiremold to provide for proper location of modern fluorescent lighting units, and also on each column to connect with existing wiring to provide outlets for fans and office machines.

WHAT WAS USED



With easily installed Wiremold Raceways and a minimum number of well designed Wiremold fittings, every type of installation may be completed all the way "from panel boxes to outlets". Wiremold is unobtrusive, strong, safe and permanent. Later changes or additions are quickly and easily made.

HOW IT WAS USED



In this case Wiremold No. 500 Raceways and fittings were used throughout. Where additional capacities are required, No. 700, No. 1000 and larger Raceways may be used interconnecting one with another to provide a complete wiring system. Many office wiring layouts will also use No. 1500 or No. 2600 "Pancake" Wiremold Overfloor Systems for telephone connections to desks and Plugmold plug-in-anywhere Systems to provide convenience outlets for lamps, appliances or machines.

Write for Engineering Data Sheets and other literature showing how and where Wiremold can help you complete your postwar wiring modernization program faster, more effectively and often at lower cost.

THE WIREMOLD COMPANY... HARTFORD 10, CONNECTICUT
ELECTRICAL CONTRACTORS



Business publications like these, with aggregate circulation of over 240,000 monthly among your prospects and customers, carry Wiremold advertising messages designed to **HELP YOU BUILD BUSINESS**. Tie in with this aggressive promotion program.



For Better "Industrial"
Sound Business . . .

Look into
BELL
VOICE-
PAGING
Equipment



BELL SOUND SYSTEMS, INC.

1196 Essex Avenue

Columbus 3, Ohio

Export Office: 4900 Euclid Avenue, Cleveland 3, Ohio

The complete line of nationally popular BELL Sound Systems includes the *right* answer to every need for plant-wide "voice-coverage." Bell Voice-Paging Equipment gives management direct, "personalized" contact with all employees . . . permits attention-demanding *vocal* paging of personnel . . . and provides for plant-wide broadcasting of recorded music, time and alarm signals, announcements, and so on. Compact, standard BELL units combine in any number to fit any need, providing easy-to-service systems that can be quickly rearranged or expanded. Write for details!



WHEN
You
Need
It!

When the job calls for a new COMMUTATOR — there should be no question for the source—just 'phone, wire or write us.

• **3 FACTORIES** •
to serve you.

TOLEDO STANDARD COMMUTATOR CO. — Toledo 6, Ohio

HOMER COMMUTATOR CORP. — Cleveland 3, Ohio

HILLSDALE COMMUTATOR CO. — Hillsdale, Michigan

THE NATION'S LARGEST EXCLUSIVE MANUFACTURERS OF QUALITY COMMUTATORS

A. F. Wakefield, national president, I.E.S., suggested that I.E.S. function to pool the best thinking of all branches of the industry to solve the present day problem of bringing daylight indoors to provide comfortable vision. Then tenable and safe conclusions can be reached with respect to artistic factors involved in illumination, he concluded urging all members to actively participate in committee work.

"Let's tell the story of better lighting with enthusiasm," urged I. L. Milling, Wisconsin Electric Power Co., at the conference banquet. We have the equipment and manpower and know the technique, he pointed out. Knowing and believing in the facts of this business, we must reveal them in such a way that the benefits of better lighting will be understood and appreciated, he concluded.

Two highly interesting papers on glare were read at the technical sessions. Frank Lee, General Electric Company, presented a paper by Ward Harrison evaluating a system for rating the glare-producing factors of a lighting installation. The Harrison method defines the proposed "unit of discomfort glare" as the glare resulting from a source of one square inch surface, of 100 footlamberts brightness, at 10 feet from the eye, and at an angle of 10 degrees above the line of vision, with a 10 footlambert surrounding brightness. In this proposal *all principal factors of glare are evaluated in terms of equivalent size of source.* The above unit is arbitrarily given a rating of one. All other light sources will have a glare rating greater or less than one depending upon the following conditions: discomfort glare varies directly with the area and square of the brightness and inversely with the square of the distance, the square of the angle above the horizontal and the 0.6 power of the surrounding brightness.

A description of "brightness surveys" used by the Wisconsin Electric Power Company to give its customers an appreciation of the factors comprising a quality lighting job, was presented by C. N. Laupp of Milwaukee. Four types of measurements are made, he related; footcandles, ratio of illumination at the eye to illumination on the horizontal plane, brightness in the visual field and brightness from the work eye view. The significance of such measurements and an appreciation of their effect on vision are brought to the customers, he added.

In the field of lighting system design for small offices, asymmetrical layouts were proposed by A. W. Larson, Westinghouse Electric & Mfg. Co. Compared to conventional symmetrical installations, U, L, and H-shaped fixture configurations over work areas

produce much better seeing conditions, he advised. Demonstrations were made to illustrate maximum glareless illumination on desks, comfortable brightness and uniform distribution on the work area.

Applied lighting research activities of the Utilities Research Commission, sponsored by Chicago's Commonwealth Edison and affiliated companies, were outlined by M. J. Maier and E. J. Tillson. The report disclosed that the joint objectives of URC and utilities are: to prevent chaos in the lighting field; direct progress along proven paths; cement relations between manufacturers and jobbers so they will concentrate on approved equipment, set and adhere to standards of lighting quality. At present, URC is developing specifications for commercial lighting installations. When completed, these will be made available to industry groups, it was revealed.

Harmonious blending of lighting and architecture is being promoted in Cedar Rapids, Iowa, according to W. Dean Barnhizer, Iowa Electric Light & Power Company. His company, he revealed, makes architectural sketches of each single-fixture lighting job to help customer visualize what he is getting. This also makes the work of the electrical contractor much easier.

A lighting survey of 100 Dubuque, Iowa homes gave convincing evidence that residential fluorescent lighting is not being sold properly at present, stated Frank Bescher, Interstate Power Company. The survey, made by his company, also revealed that faulty fixtures are being installed and basic lighting principles being flagrantly violated. Unless lighting engineers exert their influence in the residential field, the increasing public demand for fluorescent lighting will lead to ultimate chaos, he warned.



Concentrating on a sketch being developed by F. C. Horton, president, Electric Association of Tri-Cities, at recent Midwestern Regional I.E.S. conference at Davenport, Iowa, are (L to R) W. L. Byrne, chairman, Nebraska-Iowa Chapter; P. A. Schlueter, Davenport contractor; and H. P. Wilson, secretary-treasurer, Quad City Electrical Contracting Association.

THE REFLECTOR IS THE BACKBONE OF ANY LIGHTING SYSTEM...



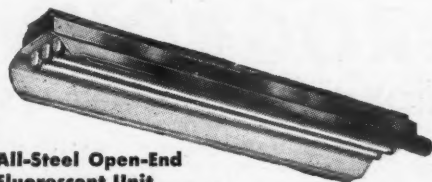
Put competition in the dark with

Skilled Lighting!

With competition coming back and factors of lower cost or higher quality looming larger in your selling plans—make Skilled Lighting your all-powerful ally. Eyes see better and hands work faster in ratio with expert lighting as surely as accuracy increases and quality improves! Worth looking into, isn't it?

The need is almost invariably for more than just "a lot of light". It calls for all-over, shadow-free, directed illumination assured by Wheeler Reflectors—maximum illumination from standard lamps! The comprehensive Wheeler line of reflectors for fluorescent or incandescent installations is built for long, efficient service—high grade, heavy duty materials with heavy vitreous enameling. Sixty-four years of specialized light engineering backs the performance of every unit.

Learn how you can lift your quality and lighten your cost load with Skilled Lighting. Write for Catalogs today. Wheeler Reflector Company, 275 Congress St., Boston 10, Mass. Representatives in principal cities.



All-Steel Open-End Fluorescent Unit

Available for two or three 40-watt, or two 100-watt lamps. Broad wiring channel with accessible, enclosed ballast. Can be mounted from chain or conduit, individually or in continuous runs.



RLM Solid Neck Incandescent Reflector Maximum lighting efficiency for either indoor or outdoor use. Expertly designed, ruggedly built. 75 to 1500 watts.

Distributed Exclusively Through Electrical Wholesalers

Wheeler *Skilled Lighting* **REFLECTORS**

Made by Specialists in Lighting Equipment Since 1881



SPEER is the logical line to handle

Motor users want the brushes that are made right for their machines. You can serve them all with SPEER because the SPEER line is complete—from appliance motor brushes to big generator brushes

Motor users want brushes of established reputation for performance. And that's SPEER again. SPEER brushes have been known nearly 50 years wherever brushes are used.

YOU want profitable repeat business. SPEER brushes satisfy—and satisfied customers come back to spend more money. Write for details on this fast-moving, easy-to-handle line.

Ⓢ 271

CHICAGO • CLEVELAND • DETROIT
MILWAUKEE • NEW YORK • PITTSBURGH



RAILROAD SIGNALING
STEAM AND ELECTRIC



TELEGRAPH AND
SIGNALING FIELDS



PUBLIC
UTILITIES



R. E. A.
PROJECTS



FACTORIES MAKING
EXPLOSIVES

Some of the many places using

ASSOCIATED RESEARCH'S

VIBROGROUND

GROUND RESISTANCE TESTER



RANGE
0-3, 0-30,
0-300, 0-3000
ohms.

Wherever protection of life and property depend on adequate electrical connection to ground, testing must be accurate and frequent. VIBROGROUND is needed. Two models provide for every condition, from average to extremes of wet and dry. MOST MODERN. Most dependable self-contained power source assures adequate power under all conditions.

NO HAND CRANKING

No laborious calculations. No reverse readings nor polarization errors. Design excludes all "strays." Push button is pressed to make direct reading, in faster time than by any other means. Compact, Portable, (shipping weight only 19 lbs.) Send for Vibroground Bulletin.

Engineering Service Representatives in All Principal Cities.

221-K SO. GREEN ST.
CHICAGO 7, ILLINOIS
PHONE STATE 5076

ASSOCIATED RESEARCH, Incorporated

School lighting techniques received considerable attention at the session. Southern Methodist University conducted a series of experiments on control of natural lighting in the classroom at the W. N. White School, Mexia, Texas. R. L. Biese, Jr., of the University staff, reported that angular translucent cloth diffusing baffles and glass blocks were both used above the center of the windows to diffuse direct sunlight without blocking it from the room as with conventional shades. A 45 degree angle, opaque, plywood baffle shading the lower 9 inches of window controls natural ventilation and shades the room from sunlight coming in the lower portion of the windows. Ratio of vertical illumination at the eye to horizontal illumination was reduced, in some instances, from 4 to less than 1. Room decoration played an important role in the experiments. The facts learned at the Mexia school, are now being applied to the modernization of 21 other Texas schools, Mr. Biese reported.

The Public Service Company of Northern Illinois is engaged in an organized promotion of better school lighting through the convincing medium of trial installations, reported W. F. Carson. Such model classrooms have been installed at the Oak Park and River Forest Township High School in Illinois. A significant factor in the success of the program, according to Carson, was the participation of school officials in experiments to determine which type of equipment best met the classroom needs. Resulting indirectly from the existence of the major school "experiment station," was a significant improvement in lighting of smaller schools in the area, he revealed.

The rest of the session was devoted to a review of six convention papers by Gerald M. Felland, Curtis Lighting, Inc. These papers appear in the current "Convention in Print" issue of the I.E.S. Transactions.

At the adjournment luncheon, L. V. James, vice-president, Midwestern Region, I.E.S., urged Society expansion as a vital factor in redeploying the lighting industry to meet peace-time lighting problems.

**SOUTHERN INSPECTORS
STUDY NEW CODE CHANGES**

The Seventeenth Annual Meeting of the Southern Section, I.A.E.I., held at the Baker Hotel, Dallas, Texas, Oct. 29-31, was an unusually spirited session. Approximately 165 inspectors and guests assembled to hear the report of Electrical Committee action on Code changes; to approve or dis-

agree with such action. Aside from the normal business transactions, the meeting resolved itself into an open forum discussion of Code articles.

Addressing the initial session, international president L. P. Dendel, Lansing, Michigan, urged code discussion meetings in all localities. The field experience of the electrical inspector is an important contribution to code making, he declared, noting that several Electrical Committee considerations were based on reports from I.A.E.I. chapters.

Ellis Knox, Miami, Fla., retiring president of the Southern Section, suggested to the assembled delegates that the I.A.E.I. should, some day, publish a book of fundamental principles and explain the code regulations with drawings and diagrams. Mr. Knox would like to see the N.E.C. written in such a manner that local inspection departments would need no special ordinances to cover specific conditions.

J. S. Mahan, Chicago, reported that the I.A.E.I. membership roster is rapidly approaching the 5,000 mark and urged members present to expand their activities to get all electrical inspectors into the fold.

W. D. Walker, Philadelphia, vice-president, International Brotherhood of Electrical Workers, declared that the I.A.E.I. is a good educational medium for electricians and explained the Union's interest in code making. I.B.E.W. is not out to dominate code making—through its representation on the Electrical Committee—but rather to cooperate in every way, he stated.

Mr. B. Z. Segall, New Orleans, declared that the Southern Section Executive Committee voted to make available to the members reprints of the analysis of the Electrical Committee report on the new code.



Two future presidents, both from Oakland, California—Ben C. Hill, superintendent Electrical Division, in vice-president of IAEI, and M. C. Sandles, Supervising inspector, Oakland, president-elect of the Southwestern Section.

The "cards" foretell good business in 1946



You can't sell promises, so we're not going to make any. We do hope, however, that improved conditions in 1946 will enable us to make the same prompt deliveries on our entire line that we are now making on Non-Renewable Fuses.

ROYAL



WIRE • CORD SETS • CARTRIDGE and PLUG FUSES • FUSTATS • TROUBLE LIGHTS • CHRISTMAS LIGHTING SETS

ROYAL ELECTRIC CO., Inc., PAWTUCKET, R. I.

HYDEE



The Sign of Quality.
Look for this label.

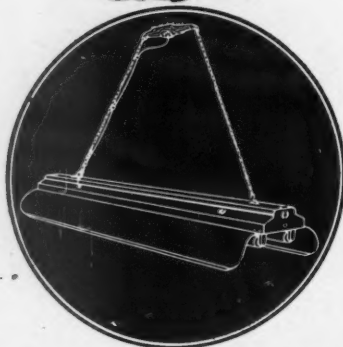
FIXTURE HANGER

Patent No.
D-141,024.
Other patents
pending.
T. M. S. Reg.
U. S. Pat. Off.



Save dollars on MAINTENANCE • REPAIRS • OPERATION ON INDUSTRIAL FIXTURES

Easy and simple to install. Simply make wiring connections—screw the hanger to the outlet box—then hang the fixture. No toggle bolts or other fastening arrangements necessary.... Self grounding—2-wire cord and plug may be used. Fits on standard 4-in. or 3 1/4-in. outlet box or plaster ring.



Complete with two 5-ft. chains, cord clips, "S" hooks and receptacle.
UNDERWRITERS APPROVED

\$1.50
LIST PRICE

DAY-BRITE LIGHTING, INC.
8403 BULWER AVENUE • ST. LOUIS 7, MISSOURI



Nationally distributed through leading electrical supply houses

Bakelite Boxes and Covers



Nos.
3050 & 4050



Nos.
3051 & 4051



Nos.
3053 & 4053



No. 6050



No. 5051



No. 5053



No. 5055



Nos.
1056 & 4056



Nos.
1057 & 4057



No.
4055



No. 7050

are the answer on every non-metallic wiring job.

CLAMPS, with every switch and outlet box, so designed as to completely close knockouts, regardless of size or shape of conductor, loom or insulation.

All knockouts take every, normally used, wire size.

Safe, Practical and Permanent.
Prompt deliveries from jobbers, centralized warehouses and our factory.

UNION INSULATING CO., INC.

P. O. Box 351 • Parkersburg, W. Va.

The 1946 National Electrical Code then came up for detailed review and discussion with the following panel of experts designated to answer questions and interpret the new changes: Frank Camus, Shreveport, La.; V. H. Tomley, Chicago; L. P. Dendel, Lansing, Mich.; R. B. Shepard, New York City; H. G. Knoderer, Bridgeport, Conn.; B. Z. Segall, and George Welton, New Orleans.

Reports on new code changes were essentially the same as those presented at the Western Section meeting in Chicago (E. C., pg. 199-204, Nov. 1945). A few additional points brought out in the discussions were:

Type T conductors will now have a wax finish on the insulation to facilitate pulling them into conduits and raceways.

Under the new code, use of continuous fluorescent fixture installations on a branch circuit raceway will not be permitted. Only one branch circuit—that feeding the group of fixtures of the specific circuit—will be allowed. Feed-through of additional circuits to connect adjacent fixture groups is not permitted. This rule is contingent upon approval of the fixture body as a raceway. Weight of metal in present fixture assemblies will not meet raceway metal specifications.

Use of underground piping on a farm for a ground system will be covered in Article 300, General Requirements, with the statement "continuous underground water piping network system."

As a result of a proposal transmitted from the Shreveport meeting last spring, the Electrical Committee recommended that a Special Committee be formed to study the problems of the petroleum industry and the possibility of forming a new section of Article 500 in the code to take care of these hazardous areas.

The Electrical Committee also appointed a Special committee to study the need for protection against static discharges on busway systems, and prepare necessary regulations to correct the condition. This action was based on a proposal also originating at the Shreveport meeting last spring.

The final sessions opened with a report by a delegation of petroleum industry representatives reporting on the various conditions encountered in the oil fields and refineries. Their philosophy, it appears, is that the best available equipment is not good enough and they always try to go one better than the code. Specifically, in the petroleum industry:

1. Each individual spot in the refinery presents a separate problem.
2. Moisture and condensation are big problems—heaters can be used to

trical Code
 review and
 ng panel of
 er questions
 ges: Frank
 H. Toss
 el, Lansing
 York City
 ort, Com
 e Welma

 anges were
 e present
 meeting in
 -204, No
 nts brought
 :
 now have
 n to facil
 nduits an

 of contin
 allations
 will not b
 ch circuit
 fixtures
 be allowed
 circuits
 oups is n
 contin
 ture be
 f metal
 ill not me
 s.
 ping on
 will be co
 al Requir
 'continua
 g netwo

 transmitt
 etting la
 Committ
 al Commi
 problems
 the poss
 section
 take care

 e also ap
 ee to stud
 ainst statu
 ns, and pr
 to correct
 was bas
 ting at th
 ring.
 with a re
 roleum
 ting on th
 er in the
 heir philo
 best arab
 enough
 better than
 petroleum

 in the re
 problem.
 sation an
 be used in

large equipment enclosures but are impractical in small housings.

3. Sleeve bearings on the larger motors seem to do a better job than ball bearings.

4. Sealing of raceways is of vital importance. There is a new compound on the market that does a better sealing job than litharge and glycerine.

After the discussion, the conference approved the following resolution proposed by Frank Camus:

"Article 500 Committee—We suggest that Articles 500, 510 be broken up in the manner similar to Chapter 3, and that the general requirements for hazardous locations be covered by an Article 500 Committee, with special committees serving the special application covering all subjects which might be classed as hazardous locations. The chairman of these committees to be a member of Article 500 general committee, consisting of members familiar with hazardous locations."

Two different schools of thought were in evidence at the Western and Southern Section meetings. At the Chicago meeting, some inspectors felt that the N.E.C. did not go far enough into detail with respect to specific applications—particularly in the hazardous location field. They felt that too much responsibility was placed on the discretion of individual inspectors who must rule on degree of hazard. A slight trace of the opposing view was brought out at the Dallas meeting; that is—the N.E.C. should consist of only basic rules with the individual inspectors having more authority to treat specific applications.

The technical sessions were concluded by H. N. Dreere of N.E.M.A., New York City, who presented a film depicting the manufacturing and installation techniques employed with armored cable.

At the final business session the following officers and directors were elected: President—G. M. Ross, Sheffield, Ala.; first vice-president—M. G. Folkes, Richmond, Va.; second vice-president—B. Z. Segall, New Orleans, La.; secretary-treasurer—A. M. (Gus) Miller, Richmond, Virginia. Elected to serve on the Executive Council were: E. C. Knox, Miami, Fla.; and A. M. Miller, Richmond, Va.

Members of the Executive Committee are: Roy Speights, Richmond, chairman; C. S. Whitaker, Durham, N. C.; A. E. Hancock, Austin, Texas; L. A. Turnage, Hartsville, S. C.; and C. V. Porbes, New Orleans. Representatives on the Electrical Committee are: N. E. Cannady, Raleigh N. C.; and J. G. Fisher, Jackson, Mississippi.

The 1946 meeting of the Southern Section will be held at Ashville, N. C., October 14-16 inclusive.

No Expense—No Upkeep

after Installing

SORGEI AIR-COOLED TRANSFORMERS

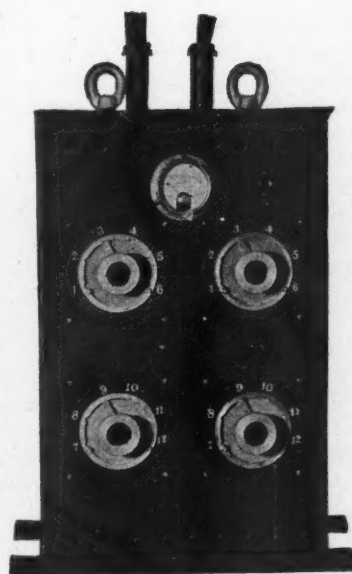
Being Air-Cooled, there is no liquid to replenish or check.
Nothing to replace or maintain.



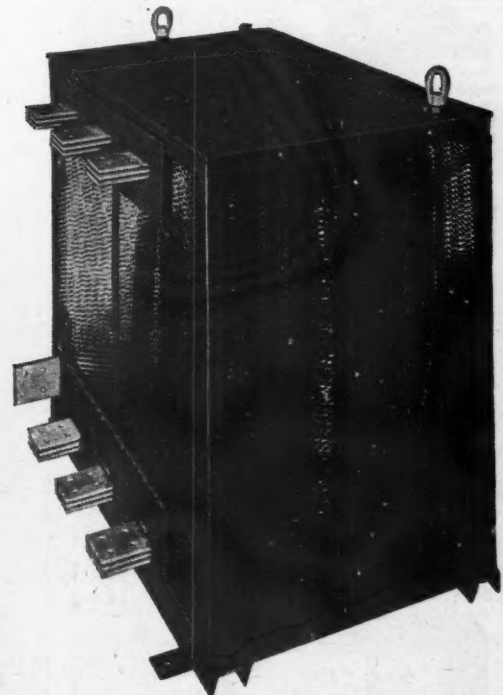
1 KVA. 3-phase

- Economical installation.
- Floor or wall mounting.
- No extra brackets.
- Single and poly-phase units.
- No complicated connections.
- For conduit wiring.

A size and type for every purpose
1/4 KVA to 1000 KVA. All voltages.

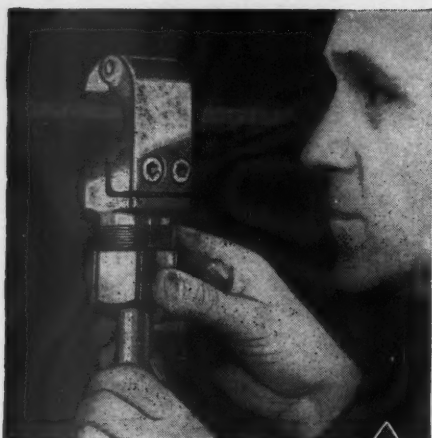


Special Furnace Transformer with adjustable tap changing switches



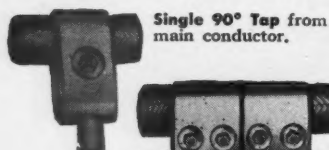
Booster Auto Transformer
1000 KVA. 3-phase. 208/120 to 240 volt.

SORGEI ELECTRIC CO., 836 W. National Ave., Milwaukee 4, Wis.
Pioneers in the development and manufacturing of Air-Cooled transformers.

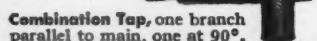


It's Easy to pick the right CABLE TAP— from the Complete line

You'll find the widest variety of parallel and 90° taps, combinations, and gutter taps—in a range of sizes up to 1,000,000 cm. Insulating Bakelite covers can be furnished for all types.



Single 90° Tap from main conductor.



Combination Tap, one branch parallel to main, one at 90°.



2-Way Gutter Tap.

Bakelite Covers can be furnished for all types of Penn-Union cable taps.



3-Way; continuous main and two separate branches.

Also a complete line of Service Connectors, Terminals, Tees, Straight and Parallel Connectors, Grounding Connectors, etc.—every good type of conductor fitting. And every one is accurately made, thoroughly tested—dependable.

**PENN-UNION
ELECTRIC CORPORATION
ERIE, PA.**

PENN-UNION

Conductor Fittings

NECA PROTESTS REA DISCRIMINATION

An attempt to prevent the Rural Electrification Administration from blacklisting electrical contractors who are performing work for privately-owned utilities at the same time that they bid on co-op construction jobs will be taken to Congress unless REA's policy is reversed before the next Agriculture appropriation bill is written.

This has been promised by officials of the National Electrical Contractors Association, whose general counsel, O. R. McGuire, has been protesting the REA position and REA's practice of negotiating contracts after bids have been opened.

Indications were that NECA would have no difficulty in obtaining sponsors for its suggested amendment to the forthcoming appropriation bill, even though there was no indication as to how such an amendment might fare on the floor. The amendment, as drawn by NECA officials, would forbid the use of any REA appropriation for payments under an REA or co-op-executed contract "which has not been let to the lowest responsible bidder after public advertising on the basis of specifications permitting full and free competition by all qualified bidders."

REA Administrator Claude Wickard verified McGuire's charges that contractors doing work for private utilities would be barred from bidding on co-op construction jobs and that REA policy occasionally calls for negotiation of contracts after opening of bids, the latter practice termed "chiseling" by NECA officials and the organization's official publication.

In a memorandum to Agriculture Secretary Clinton P. Anderson, after McGuire had filed his charges with Anderson, Wickard detailed circumstances surrounding REA's decision against allowing contractors in Michigan and in Montana to bid on co-op construction jobs because each was, at the time, engaged in work for the Consumers Power Company and the Montana Power Company respectively. Each of these companies, Wickard said, has a long record of bitter and successful opposition to co-op expansion.

Wickard's memorandum insisted that the REA blacklist policy is confined to those contractors who are performing work for private utilities at the time the co-op job is bid, asserting that "only the present activities of the contractor are considered," and adding that:

"Our policy is not based upon any attitude of retribution or any tendency on our part to attribute to contractors the 'shortcomings' of the utilities which employ them, as Mr. McGuire states in his letter, but is dictated purely by con-

siderations of self-protection which years of experience have shown to be necessary."

It was learned that, when McGuire's first complaint was raised, Wickard suggested that NECA send a committee to St. Louis headquarters of REA which would attempt to straighten out the difficulty. This was refused by NECA when it learned of Wickard's reply to Secretary Anderson, in which Wickard indicated his intention of continuing the policy against which NECA protested. The memorandum to Anderson was dated several days after Wickard's suggestion that the committee be sent to St. Louis, and was regarded by NECA men as an evidence of insincerity on Wickard's part.

In his memorandum to Anderson following McGuire's protest, Wickard declared that the Central Electric Company, of Battle Creek, Mich., was the only bidder on a project advertised last July by the Tri-Country Electric Co-op, of Portland, Mich. Central Electric's bid was rejected as being too high, but, on re-bidding, the company was advised on Aug 6 by the co-op's engineers, J. and G. Daverman Co., that it was ineligible for the re-bidding. Central sought an explanation and was informed by Avery R. Colburn, REA regional construction engineer, that "it is our policy not to approve bids of a contractor who is doing work for a private utility in a competitive area."

Wickard explained to Secretary Anderson that Consumers Power, for which Central Electric was then erecting some lines, had "a long history of hostility and damaging opposition to REA cooperatives."

Last August, Wickard went on, the Park Cooperative Electric Association, of Livingston, Mont., opened bids on a project for which the low bidder was Bennett and Lewis, of Billings. REA's regional construction engineer, one Biggelow (cq), telegraphed Bennett and Lewis Aug. 14 that its low bid would be approved only if the firm discontinued some work it was performing for the Montana Power Company. Montana Power, Wickard's memorandum asserted, "has been and still is engaged in very active opposition to our Montana cooperatives. Some of the most flagrant cases of spite-line construction that we have ever encountered have been carried on by the Montana Power Company."

In setting forth reasons for REA's policy, Wickard outlined the agency's experience with private companies which serve only selected customers in a rural area and thus render it difficult if not impossible to serve the remainder on a paying basis.

"The most effective means of combatting this 'cream-skimming' process of the private utilities is for our bor-

which
n to be
Guire's
Wickard
committee
REA
ten out
sed by
Wickard's
which
of con-
NECA
Anders-
Wick-
tee be
led by
insin-

owers to construct their lines quickly
to all of the consumers in the area be-
fore the utilities' 'spite lines' (of which
there have been many in the past) take
the heart out of the project," Wickard
declared.

The REA administrator went on to
describe the relationship between a
co-op and its contractor as "a confiden-
tial one, having many of the character-
istics of the relationship with its con-
sulting engineer and attorney." A
contractor must be able to "devote him-
self wholeheartedly" to the co-op,
Wickard said, pointing out that
"staking sheets" of proposed lines have
a "highly confidential character," and,
being turned over to a contractor work-
ing for private companies as well as
co-ops in the same area, could harm the
co-op if wrongfully used.

Contractors have a single pool of
materials, some of them hard to come
by, and should not be expected to serve
the interests of competitive customers
from them, Wickard said, adding:

"Since it is only natural that the
contractor should look after his best
customer first, and, since the utility is
usually the best customer by reason of
its larger size, the interests of the REA
cooperatives are more than likely to
suffer under these circumstances."

Wickard said that co-ops, being pri-
vate bodies, are not bound by federal
laws regarding the use of competitive
bidding. REA has insisted on this in
most cases, he said, but "we do not
feel that such a policy should extend
to the point of requiring a borrower
to accept a contractor where conflict-
ing interests are involved."

Regarding negotiation of contracts
after bids have been opened and re-
jected as excessive, Wickard disputed
the case advanced by McGuire, but
conceded that the practice has been en-
gaged in.

"There have been a number of
cases," Wickard wrote Anderson,
"where because of the present unsettled
labor and material prices, competitive
bidding procedures have not resulted in
reasonable contracts, and we have
found it necessary to authorize bor-
rowers to negotiate for a set contract
after rejecting all bids. Such cases,
however, have been the exception
rather than the rule and we believe
that when the present uncertainty as
to labor and material prices has been
cleared up, this practice may be elimi-
nated. Until then, however, we feel it
is essential that we retain the right to
approve negotiation of contracts if our
program is not to be seriously disrupted
by unreasonably high construction
costs."

In the case advanced by McGuire
as indicative of REA "chiseling," only
two of 24 contractors bid on a job
advertised by the Coles-Moultrie Elec-

DEPEND ON—INSIST ON—

P. R. MALLORY & CO., Inc.

MALLORY CAPACITORS



Necessary leads,
lugs, screws, and
nuts are included in
each box for any
type connectors.

Mallory MSG Capacitor:—Small, compact AC Motor Starting Capacitor that fits almost every mounting bracket or box. Replaces rectangular capacitors with leads, lugs or studs. Each capacitor is packed with complete set of universal mounting hardware and installation instructions.



Mallory Type "P" Capacitor:—Plastic case overcomes moisture absorption problems, and provides maximum insulation. May be used to replace cardboard insulated aluminum-case capacitors. Splash-proof plastic end cap and simplified "snap on" mounting bracket available when capacitor is used as original equipment.

Distributed by

INSULATION AND WIRES INCORPORATED

SAINT LOUIS 3, MISSOURI

BOSTON 20, MASS. DETROIT 2, MICH. ATLANTA 3, GA.
HOUSTON 2, TEX. BLUEFIELD, W. VA. NEW YORK 7, N. Y.

SITTLER COMPANY

CHICAGO 7, ILL.

H. A. HOLDEN, INC.

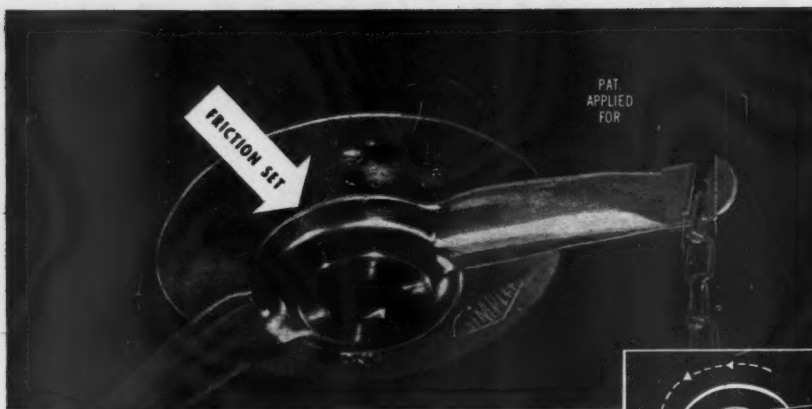
MINNEAPOLIS 3, MINN.

W. C. JOHNSON COMPANY

PEORIA 5, ILL.

TRI-STATE SUPPLY CORPORATION

LOS ANGELES 13, CAL. • SAN FRANCISCO 7, CAL. • SEATTLE 4, WASH.



NEW "Friction-Set"

FIXTURE HANGER . . .

That Adjust With a Twist of the Wrist!

At last you can get a Fixture Hanger that turns to any angle after being screwed to an outlet box. Although base and receptacle remain stationary, hanger arms may be turned to align with any preconceived lighting plan. Exclusive Friction Ring firmly holds fixture in selected position. Hanger screws on to 3/4" or 4" outlet boxes, no other fastening necessary. Furnished complete with receptacle, two 5' chains, hooks and cord clips.

Friction-Set K100 . . . List Price \$1.10



360° Adjustment



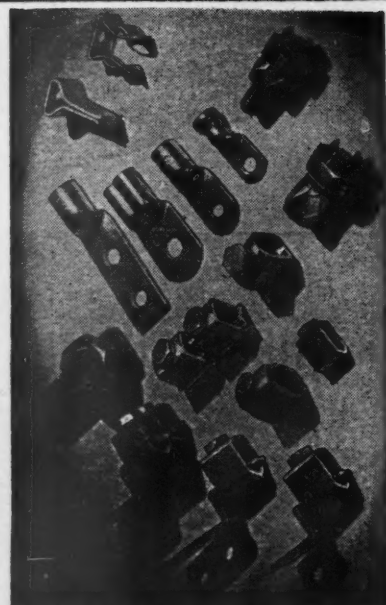
For any fixture position

SIMPLET ELECTRIC COMPANY

123 N. Sangamon Street • Chicago 7, Illinois
112 Charlton Street • New York 14, N.Y.

ILSCO

Electrical Connectors



Please send details and 48-page illustrated catalog

Name

Firm Name

Address

ILSCO COPPER TUBE & PRODUCTS, Inc.
CINCINNATI, OHIO

MR. CONTRACTOR:

HUNDREDS OF THOUSANDS OF DOLLARS ARE GOING TO BE INVESTED IN NEW SERVICE STATION LIGHTING. CAPTURE THIS BUSINESS WITH

Revere

THE COMPLETE QUALITY LINE.

Revere Elipitor 3800 Series—300, 500, 750, 1000 and 1500 watt floodlight—neat, trim, streamlined. Effective, uniform overall lighting.

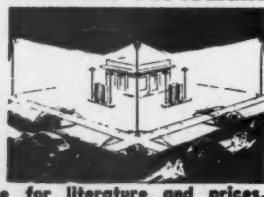
REVERE HINGED FLOODLIGHT POLE

The greatest boom to efficient floodlighting. Floodlights may be cleaned and serviced from the ground. No ladders—no dangerous climbing. Available in three heights—20, 24 and 30 feet mounting height.

THE REVERE TRIANGULAR FLOODLIGHT



The only floodlight of its kind that throws a definite 90° pattern—concentrates light on station area only. No spilled light on neighboring property or street.



Write for literature and prices.

REVERE ELECTRIC MFG. CO.

6017 Broadway — Chicago 10, Ill.

RMEL MEETS IN DENVER

The electrical contractor must play a dominant role in the industry's reconversion program if manufacturers' products and power companies' energy output are to meet in the ultimate consumer's home, business or industrial establishment. He must consolidate his technical knowledge with that of architects, builders, electrical inspectors, building inspectors and municipal authorities in his own interests. Adequate wiring is the key and bottleneck that will control electrical development in the immediate future.

These conclusions were impressed upon the delegates to the Rocky Mountain Electrical League's fall conference, October 25-27 in Denver. All branches of the industry from Colorado, Wyoming, New Mexico and parts of South Dakota were represented.

Following President F. F. McCammon's keynote address, E. S. Northup, field representative of the National Adequate Wiring Bureau presented the NAWB promotional program. The one item of 7,000,000 homes to be modernized, he pointed out, offers a gigantic field for adequate wiring and adequate installation. Wiring as a structural necessity, Mr. Northup said, is being taught by NEMA by Home Builders Institutes and other agencies.

R. E. Johnson of Sturgeon Electric Company, Denver spoke on "Coordination with Architects, Contractors, Wiremen and Inspection Authorities". Mr. Johnson proposed as immediate measures to merge electrical contractors' interests with those of allied professions by (1) An affiliation, through useful collaboration, with architects (2) Collaboration with building contractors (3) Close coordination with electrical inspectors and (4) A study of municipal wiring and safety laws with a view to stepping up adequacy, either voluntarily or by ordinance.

Other speakers were R. N. Hankins, Sechrist Manufacturing Co. on "Future of Indoor Lighting"; P. E. Brookover Public Service Co. of Colorado on "Rural Power and Power Load Growth"; "Appliance Availability and Lord Growth" by Dick Isaacs, Westinghouse Electric Corporation; and "Plans of Electrical Dealers" by Herb Names, of Herb Names, Inc., Denver.

The new officers elected were: president, Luke R. Storey, Home Gas and Electric Co., Greeley, Colo.; vice presidents: W. D. Johnston, Mountain States Power Co., Casper, Wyo.; F. H. Wiley, Colorado Springs Light and Power department (municipal); M. C. Heffelman, New Mexico Power Company, Santa Fe, N. M., and A. S. Anderson, General Electric, Denver.



Taking an active part in discussions on proposed Code changes at the Eastern Section IAEI Annual Meeting, New York, N. Y. were (L to R): Dominick F. Paduano, Elec. Inspector; John W. Hager, Assistant Chief Elec. Inspector and member Executive Council, IAEI; and Anthony Angelo, Elec. Inspector—all of the Department Water Supply, Gas and Electricity, City of New York.

—Book Review—

ELECTRONICS DICTIONARY

A new electronics dictionary, recently published, will be of interest to any individual working or studying in any of the phases of the broad field of electronics. Beginners who are interested in learning about electronics, engineers who must develop applications for electronic equipment, and those who must use and maintain such equipment, will find the definitions clear-cut and easily understood.

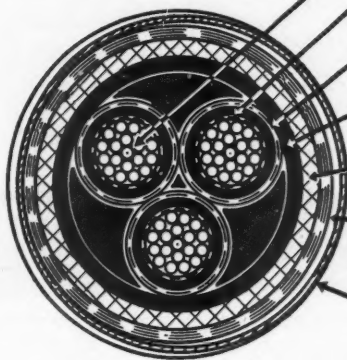
There are nearly 6500 terms listed in this up-to-date, well illustrated glossary. They are the terms used in radio, television, industrial electronics, communications, facsimile, sound recording, and similar phases of the electronics field. More than 600 appropriate diagrams and sketches have been used, which add to the book's usefulness and interest.

An important feature of this dictionary is its treatment of abbreviations. A consistent policy for abbreviating electronic terms, based upon the groundwork laid by American Standards Association has been followed, resulting in only one abbreviation for a given term, regardless of grammatical usage.

Electronics Dictionary contains 433 pages, and is 6 in. by 9 in. in size. Its authors are: Lieut. Comm. Nelson M. Cooke, USN., and John Markus, Associate Editor, *Electronics*. It is

Insure STEADY PERFORMANCE

PROTECT WITH DELTABESTON CABLES



A. Copper B. Felted Asbestos C. Varnished Cambric
D. Belt Insulation E. Lead Sheath F. Jute Bedding
G. Interlocking Armor

One of the safest ways to insure steady performance in circuits that run around boiler rooms, steam tunnels, furnaces and other severe operating places is to protect with G-E Deltabeston Asbestos-insulated Cables. Unexpected cable failures in power, lighting or control circuits can make your plant lose production and profits. Why take unnecessary risks? Make an inspection trip around your power plant, check the torrid zones where heat, moisture and corrosive vapors are busy at their destructive work and rewire with Deltabeston Asbestos-insulated Cables.

The Deltabeston product shown here is a three-conductor power cable with lead sheath, jute bedding and interlocking armor. It was designed for a central station to handle high current densities, during peak load periods. It has fine resistance to high ambient temperatures. It's flame-proof and physically tough. The armor takes the place of rigid conduit and gives the cable the same protection. Construction without interlocking armor or jute bedding can be supplied. Also available with asbestos braid instead of lead sheath. There's a Deltabeston Cable for every installation where heat, flame, moisture, oil, grease and corrosive vapors are a problem.

For additional information write to Section Y1256-B, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Conn. Deltabeston Cables are distributed nationally by Graybar Electric Co., G-E Supply Corp., and other G-E Merchandise Distributors.

BUY ALL THE BONDS YOU CAN—AND KEEP ALL YOU BUY

GENERAL  ELECTRIC



Cast Lug Performance at a Stamped Lug Price

Each part of Frankel Flexilugs is precision-built of special materials to assure maximum overall performance. Each Lug fits many wire sizes. Works equally well on solid, stranded, flexible and extra flexible cable. All current in lug carried through 100% conductivity copper which makes full contact around the wire.



Catalog 4-C mailed upon request

FRANKEL CONNECTOR CO.
27 VESTRY STREET · NEW YORK 13, N. Y.

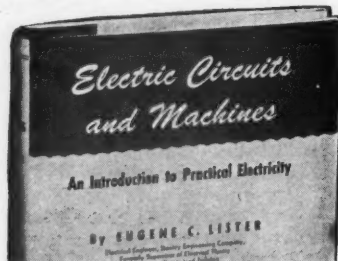
For a quick, sure knowledge of electric circuits and machines

Through a single, practical manual

- both direct and alternating current
- minimum of mathematical explanation

THIS expertly-written manual supplies you with a clear, concise description of the broad field of both direct and alternating current electric circuits and machines between the covers of a single volume. It does this with a few mathematical explanations and analogies as possible, using only simple algebra when necessary.

Here is a practical manual for the professional man—demonstrating the physical action that takes place, rather than analyzing the theory behind. It will help you to master all of the vital elements of modern electrical usage.



Just published!

ELECTRIC CIRCUITS AND MACHINES

An Introduction to Practical Electricity
By EUGENE C. LISTER

Electrical Engineer, Stanley Engineering Co.; Formerly Supervisor of Electrical Theory Instruction, Specialized Training Program, Iowa State College.

358 pages, 5 1/4 x 8 1/4, 233 figures, \$3.50

HERE is a completely practical, highly instructive manual which will guide you through the intricacies of circuits, batteries, magnetism, induction, generators, various kinds of motors and controls, transformers, alternators, electrical instruments and electronic tubes more simply and easily than you ever thought possible. It has been written for the man who needs a good overall understanding of the field, yet doesn't want to spend hours poring over irrelevant theory. Text material is illustrated with hundreds of figures and diagrams—the appendix supplies you with handy wiring diagrams, symbols and a number of helpful tables.

Check over these topics:

- Construction of the Edison cell
- Factors affecting the amount of induced emf
- Generator action of a motor
- Automatic control of D-C motors
- Transformer construction
- The repulsion-start induction motor
- Electronic tube elements
- The grid-controlled gas-filled tube

**SEE IT
10 DAYS
FREE**

**SEND
COUPON**

McGraw-Hill Book Co., 330 W. 42 St., N.Y.C. 18
Send me Lister's *Electric Circuits and Machines* for 10 days' examination on approval. In 10 days I will send remittance, plus few cents postage, or return book postpaid. (Postage paid on cash orders.)
Name
Address
City and State
Company
Position EC 12-45
In Canada: mail to Embassy Book Co.,
12 Richmond St. E., Toronto 1.



Cornered during a "seventh inning stretch" at recent Chicago conference of the International Association of Electrical Leagues are (L to R) H. F. Bennetts, Kansas City Electric Association; Sheridan Taylor, Electrical Association of Philadelphia; Elias J. Strong and Ora H. Barlow of the Intermountain Electrical Association, Salt Lake City, Utah.

published by the McGraw-Hill Book Company, Inc., 330 W. 42nd Street, New York, 18, New York, and is available at \$5.00 per copy.

INDUSTRIAL ELECTRIC LAMPS AND LIGHTING

Combining theory and application with detailed instructions for use with proper type reflectors for indoor and outdoor lighting "Industrial Electric Lamps and Lighting" covers every type of industrial lamp. For the student, architect, engineer or electrical contractor working with lighting designs and applications, it forms an excellent reference book, combining under one cover technical data on light sources, types of reflectors or equipment, a chapter on lighting design, wiring data, etc.

Modern lighting is approached from the science of seeing angle in the first chapter, in which factors entering into the design of a lighting layout are discussed briefly. Light sources discussed include the tungsten filament lamp in its multitude of sizes, shapes, colors, types and characteristics, as well as mercury, sunlight, fluorescent, bactericidal and black light lamps. Over 200 illustrations are used, as well as many tables which will be found useful in lighting design and calculating. Written by Edwin S. Lincoln, Consulting Engineer and Fellow AIEE "Industrial Electric Lamps and Lighting" is published by Essential Books, 270 Madison Ave.,

New York
in s
price is

ELEMENTS
ELECTRIC

The
tron
dustry,
strumen
language
Engine
written
much
electron
that it
practical
applica
everyda

The
planatic
and, wi
logical
differen
commen
tire bo
introduc
derlying
been fu
sible, u
draulic

Ther
chapter
cussion
and pr
princip
various
into the
which
sented.
cloth bo

Report
Action
presen
IAEI
Ward,
Chief
Paterso

New York 16, N. Y. It is 5½ in. by 8½ in. in size, contains 342 pages, and its price is \$3.00.

ELEMENTARY ENGINEERING ELECTRONICS

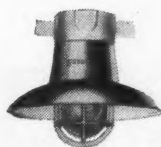
The fundamental principles of electron tubes, and their applications in industry, particularly in the field of instrumentation, are presented in simple language in a new book, "Elementary Engineering Electronics." It has been written so that it does not require too much background knowledge about electronics, and yet not so elementary that it will fail as a practical guide for practical men seriously interested in the application of electron tubes in their everyday work.

The book begins with a simple explanation of the nature of electricity and, with this as a foundation, proceeds logically to explain the action of all the different types of electron tubes in commercial use. Throughout the entire book no new principle or action is introduced until the fundamentals underlying such principle or action have been fully disclosed. Whenever possible, use is made of mechanical or hydraulic analogies.

There are 34 conveniently short chapters. The book begins with a discussion of "The Nature of Electricity," and proceeds through descriptions, principles, and characteristics of the various tubes, tube applications, and into the "conclusion" or final chapter in which control and regulation is presented. There are 344 pages in this cloth bound book, size 5 by 8½ inches,



Rugged Lightweight! GOODRICH VAPORLITES



With Shallow
Dome Reflector



With Angle
Reflector



With Guard Only

Designed to serve a wide variety of industrial applications, Goodrich Vaporlites are constructed entirely of cast aluminum, combining light weight with ruggedness and corrosion-resistance. Here's lasting protection and freedom from service interruptions.

Listed as vapor-proof by Underwriters' Laboratories, Goodrich Vaporlites assure complete safety. The lamp itself is glass enclosed and protected by a heavy guard. A gasketed socket seals the wiring chamber to make it completely airtight.

You can fit Goodrich Vaporlites to your exact lighting requirements with standard dome, shallow dome, or angle reflectors, finished in permanent porcelain enamel. Reflectors are independently mounted to permit easy removal of globes and guards. Write for literature.

Sold Through Electrical Wholesalers

GOODRICH
ELECTRIC COMPANY
4600 BELLE PLAINE AVENUE, CHICAGO 41, ILLINOIS



Report of Electrical Committee Action on Article 410, Fixtures, was presented to the Eastern Section, IAEE Annual Meeting by C. A. Ward, Fourth Vice-President, and Chief Electrical Inspector, City of Paterson, N. J.

*COLOVOLT COLD CATHODE INDUSTRIAL FIXTURES



Here is the new Colovolt industrial fixture, one of a complete line of industrial and commercial "packaged" units. Equipped with the standard 93" Colovolt 10,000 hour lamp, Colovolt fixtures may be used singly or in continuous line lighting in multiples of 8 feet. Instantaneous starting, no flickering, guaranteed for 1 year ex-

cept for failure due to breakage are extra advantages of the Colovolt Cold Cathode low voltage fluorescent lamp. The long life expectancy of Colovolt lamps may be realized even when constantly turned on and off, and pre-scheduled re-lamping, with no loss of production or time, is now possible with Colovolt installations.



*Trade mark registered U. S. Pat. Off.

Contact your electrical wholesaler or jobber, or write us for full details and prices.

GENERAL LUMINESCENT CORPORATION

672-S, FEDERAL STREET

CHICAGO 5, ILLINOIS

Bend Conduit Cold-

Here's How



Conduit can be bent



to any desired angle



without moving pipe



in one operation

up to 90 degrees
in one single operation
with Tal's Prestal
Pipe Bender

Installation work goes faster, easier, and at a lower cost when you have a Tal's Prestal Bender on the job. This efficient, light, portable machine handles all pipe and conduit up to 3". Makes perfect bends, up to 90°, cold, in one single operation. No need to waste labor by replacing the pipe three to six times to make a bend. Does a good workmanlike job — smooth, uniform bends without kinks or wrinkles.

Simple and easy to operate. Thousands are in successful use everywhere. Write for data bulletin.



Tal's Prestal Bender, Inc.

Dept. EC-12, Milwaukee 2, Wisconsin

and it contains over 250 numbered illustrations. The author is Andrew W. Kramer, Managing Editor of Power Plant Engineering, Member AIEE, Associate Member IRE. It is published by Instruments Publishing Company, Pittsburgh, Penna. Price \$2.00 postpaid.

MANUFACTURERS NEWS

GENERAL ELECTRIC CHANGES

The Motor Division of General Electric's Apparatus Department has been reorganized, being separated into four divisions and one section.

W. H. Henry, formerly manager of the Motor Division, is appointed assistant manager of the newly-created electronic charge of the motor business. The following Division managers have been appointed: A. W. Bartling, manager Fractional Horsepower Motor Division; Elliott Harrington, manager Induction Motor Division; J. T. Farrell, manager D-C Motor Division; and P. A. McTerney, manager Synchronous, Large D-C, and Generator Division.

E. A. Green, who during the war has been on war manufacturing assignments, returns to the motor organization as general assistant to Mr. Henry. D. E. Moorhead, who recently returned from the armed forces, is appointed assistant to Mr. Henry to give particular attention to motor sales activities. O. F. Vea continues in charge of the motor marketing and promotion section and A. A. Merrill in charge of forecasting, order budgets and statistics group for all motor lines.

The transfer of G-E's Standards Division from the Apparatus to the Executive Department, with L. F. Adams as manager, has been announced. At the same time announcement was made of the establishment of the Standards Advisory Committee with Mr. Adams as chairman, H. W. Robb as secretary and a representative from each department.

The Navy Ship, Merchant Ship, and Diesel-Electric Divisions, now a part of General Electric's Federal and Marine Divisions, have been consolidated into a new Marine Division. Simultaneously, announcement was made of the appointments of E. K. Henley as manager and W. H. Wild as sales manager of the new Marine Division and the transfer of F. C. Ruling to Washington, D. C. as assistant manager of G-E's office there.

L. D. T. Berg, for the past five years a sales engineer in G-E's Welding Division, Schenectady, has been appointed welding specialist of the company's Atlantic District with headquarters in Philadelphia.

The appointments of Clayton P. Dunne as manager of the newly-organized New York Appliance Sales District of G-E and Carleton A. Reeves as manager of the company's Northeastern Appliance

Sales District, Boston, have been announced.
Don C. Ross has been appointed representative in Kansas City, Mo. for G-E clocks, fans, heaters, sunlamps, heat lamps and heating pads.

The appointment of J. A. Foley as manager of the East Central District of the General Electric Credit Corporation has been announced.

Harold A. Olson, who for the past six years has been assistant manager of G-E Lamp Department's Atlantic Sales District in New York City, has been named manager of that district. Mr. Olson succeeds Herbert B. Hyrtle, who will continue to serve Atlantic District in an advisory capacity.

Warren P. Thayer, for many years a salesman with the lamp department's Midwest District, has been named manager of Midwest Sales District in Kansas City. Mr. Thayer succeeds Everett G. Agee, who became assistant manager of Atlantic Sales District.

William H. C. Lehman, for the past five years a member of the Apparatus Agency Division of General Electric's Industrial Divisions, Schenectady, N. Y. has been appointed assistant manager of apparatus sales of the General Electric Supply Corp., Bridgeport, Conn.

APPLETON ELECTRIC APPOINTMENTS

Appleton Electric Company, Chicago, announces the appointment of William A. Davidson as Pittsburgh district manager with offices at 418 Bessemer Bldg., Pittsburgh, Pa. He succeeds C. L. Snyder, who has retired.

Luther D. Shank has been appointed district manager of the Philadelphia office, with headquarters at 1217 Race Street. Mr. Shank was formerly with the War Production Board where he was chief of the Electrical Materials Section.

LT. COL. DIBNER RETURNS TO BURNDY

After nearly four years of Military service, Lt. Colonel Bern Dibner returns to



LT. COLONEL BERN DIBNER

VAPOR TIGHT

LIGHTING FIXTURES

EXPLOSION PROOF

40 Years' experience plus modern design is built into every R&S product.

R&S reflector contours are scientifically designed with high reflection factor providing a maximum of safe controlled light at minimum cost.

Thorough inspection and rigid factory controls insure longer life and low maintenance.

R&S explosion-proof lighting fixtures are supplied with a standardized base common to all sizes. Reflector globe assemblies of various capacities are interchangeable to suit conditions. No need to disturb mounting or electrical connections. Modern design simplifies mounting and affords a variety of conduit arrangements in one standard base. Installation costs are lower, parts fewer and ordering easier.

In hazardous areas, you can't afford to experiment. R&S explosion-proof and vaportight lighting fixtures are precision built and pass the rigid tests of Underwriters' Laboratories.

Specify R&S and be sure. Write for our 300-page catalog. You will find it valuable in planning new work and bettering existing installations to meet tomorrow's standards.

Since 1902

Please address
Dept. No. A



RUSSELL & STOLL COMPANY

EXPLOSION-PROOF, WATER-TIGHT, INDUSTRIAL LIGHTING FIXTURES
AND EQUIPMENT. AUTOMATIC LOCKING "EVER-LOK" CONNECTORS
125 BARCLAY STREET • NEW YORK 7, N. Y.



Electrically Lighted Switch Plate!



CUSTOMERS WANT IT ...Extra Profit for You!

Cash in on the universal popularity of LumiNite, the strikingly attractive switch plate with the sealed-in electric glow lamp that turns on and off automatically as the switch is operated! Check on the many advantages listed below and you'll quickly see why your customers will appreciate your recommending and using LumiNite.

BEAUTIFUL
IVORY
or brown
PLASKON

OPERATES
ON 2, 3
and 4-WAY
SWITCHES

SPECIAL
UNITS FOR
MULTI-GANG
SWITCHES

Listed By Underwriters

- Lights automatically when you turn room lights off!
- Goes out when room lights are turned on!
- Ends fumbling for switches in the dark!
- Provides a "safety" glow, helps you avoid stumbling!
- Keeps wall free of smudges from groping hands!
- Shows when you've forgotten to turn remote lights off!
- Serves as comforting night-light in nursery or bedroom!
- Operates for less than 2c per year!
- Lasts for years without a burnout!
- Backed by an unconditional renewal guarantee!

List
Price
\$1.00

"The Standard for
Light Switching"

ASSOCIATED PROJECTS CO.

80 E. Long St., Columbus 15, Ohio

his civilian post at the helm of Burndy Engineering Company, New York.

Lt. Colonel Dibner took leave from his company in 1942, to volunteer his services to the U. S. Army. He was given the rank of Captain, and, because of his technical knowledge and ability, was assigned to special work with the Army Air Forces Proving Ground Command and later with the Strategic Bombing Survey in Europe in 1944.

SYLVANIA PROMOTIONS

E. Finley Carter and H. Ward Zimmer were elected vice presidents of Sylvania Electric Products at a meeting of the Board of Directors last month.

Mr. Carter, who joined the company in 1932 as an engineer and who has been Director of Industrial Relations since 1941, becomes vice president in charge of Industrial Relations.

Mr. Zimmer has been general manager of operations of the Radio Division since 1943 and he now becomes vice president in charge of the Radio Tube Division.

D. R. DOOLEY WITH CLARE & COMPANY

D. R. Dooley has been appointed vice president in charge of sales of C. P. Clare & Company, Chicago. Formerly assistant sales manager of Automatic Electric Sales Corporation, Mr. Dooley has long specialized in the application of relays and switches to electronic and other industrial uses.

GRAYBAR APPOINTMENTS

On November 1, Herbert Metz took over the duties of assistant Eastern District Manager for the Graybar Electric Company, with headquarters at 180 Varick Street, New York City. He has served since 1939 as general lamp and lighting sales manager in the company's executive offices.



HERBERT METZ

Now Available— Your guide to precise usage in working with ELECTRONICS terms

6500 clear-cut
definitions and
reference data



HERE is the book that every electronics and radio man has been looking for — an up-to-date, comprehensive dictionary covering all the terms used in electronics and its extensive practical applications, radio, television, communications, and industrial electronics.

For clear, precise definitions, accurate usage, well-illustrated descriptions, and for standardized spelling, abbreviating and hyphenating policy, this book will be a constant aid to everyone working with electronics and radio engineering—whether student or engineer, editor, or engineering secretary.

Just Out!

ELECTRONICS DICTIONARY

By NELSON M. COOKE, Lt. Com. USN
Executive Officer, Radio Materiel School
Naval Research Laboratory, Washington, D. C.

and JOHN MARKUS
Associate Editor, Electronics

433 pages, 5 3/4 x 8 3/4,
over 600 illustrations, \$5.00

NOW at last here is an authoritative work to clarify and define the myriad new terms that have come into usage with the vast growth of electronics and electrical engineering. Nowhere else will you find a dictionary comparable to this in scope and timeliness. Nowhere else will you find such a thorough, extensive, generously illustrated compilation.

This glossary fully covers terminology, principles, processes, equipment, abbreviations, and colloquialisms in

Radio
Television
Industrial Electronics
Sound records
Communications
Medical Electronics
Electronic heating
Electronic welding

Photoelectric controls, safety
devices, and intrusions
detectors
Facsimile
Electronic motor control
Long-distance telegraph and
telephone

This excellent dictionary should be of constant usefulness both to the technician and to the most advanced electronics engineer, for its definitions are exceptionally precise and accurate, and in most cases, each is complete in itself. Invaluable for its consistent abbreviating and hyphenating policy.

Send for a free-examination copy

McGraw-Hill Book Co., 330 W. 42nd St., N. Y. 36
Send me Cooke and Markus' ELECTRONICS
DICTIONARY for 10 days' examination, on ap-
proval. In 10 days I will send \$5.00, plus five
cents postage, or return book postpaid. (Postage
paid on cash orders.)

Name
Address
City and State
Company
Position
In Canada: Mail to Embassy Book Co.,
12 Richmond St. E., Toronto 1

Donald R. Edge has been appointed assistant rural lines sales manager for Graybar. He will make his headquarters in Chicago.

Edwin Black, recently returned from service with the Army Air Forces, has been named assistant to vice president E. W. Cashman at general headquarters in New York City.

C. E. Kirkpatrick has been appointed manager at Albany, New York. He is replacing J. J. Portley who is retiring from the company.

Aubrey L. Jordan is taking over the duties of merchandising manager for Graybar in Nashville, Tenn., and C. A. Turner has been appointed merchandising manager in Des Moines.

WAGNER CHANGES

Wagner Electric Corporation of St. Louis announces that J. D. Eby, manager of purchases, was elected secretary of the company to succeed the late J. W. Westcott. Mr. Eby assumes these new duties in addition to his present responsibilities as manager of purchases.

K. G. Baker is back with the Indianapolis office of Wagner Electric as a field engineer after over three years' active duty with the Army.

O. Z. ANNOUNCES NEW DISTRIBUTION PLAN

A new sales policy has been adopted for the distribution of the O. Z. line of electrical products, by the O. Z. Electrical Manufacturing Company in Brooklyn, N. Y.

Starting January 1, stocks will be carried by electrical distributors in principal cities from coast to coast and direct sales by O. Z. will be discontinued.

Maguire Industries, Inc. has announced the appointment of Robert M. Karet as manager of the newly-created electronic distributor and industrial sales department of the company. Under Mr. Karet's direction, all distributor and industrial sales of Maguire subsidiaries serving the electronic field will be coordinated. Mr. Karet will make his headquarters in the Chicago office at 936 North Michigan Avenue

The Acme Electric & Manufacturing Company of Cuba, New York has announced the sale of its Clyde, New York plant to the General Electric Company of Schenectady, N. Y. They took possession on December 1, 1945. This factory will

**50% LABOR SAVING
ON JOB TAKING 2½
CARLOADS OF CONDUIT**



"A recent big job of ours called for the installation of 2½ carloads of conduit in various sizes. All of this was bent with a GREENLEE Hydraulic Bender and we saved at least 50% in labor hours and 10% on fittings and manufactured bends."

"This is typical of our several years' experience with a GREENLEE," reports Harry C. Korns, owner of Harry C. Korns Electric Co., St. Joseph, Mo.

You, too, can speed installations with a GREENLEE Bender...and savings made on one job such as above will more than pay for it!

Compact, portable, easily set up so that one man can quickly bend pipe up to 4½", rigid and *thin-wall* conduit, tubing, bus-bars... right on the job!

Whatever your bending needs, there is a GREENLEE to do the work. For complete information on GREENLEE Hydraulic and Hand Benders and other timesaving tools get free Catalog 33E. Greenlee Tool Co., Division of Greenlee Bros. & Co., 1812 Columbia Avenue, Rockford, Illinois.



OTHER GREENLEE TIMESAVING TOOLS FOR ELECTRICAL WORK
Hand Benders • Joist Benders • Cable Pullers • Knockout Tools • Pipe Pushers



• Back on a peace basis once more! That means the Aerovox line of motor-starting capacitors once again includes the widest selection of both exact-duplicates and those universal types that served so well during the war shortage. You can now get replacements exactly matching the units you're replacing—even to such details as the insulating jacket, as here shown. Yes, be sure to make it AEROVOX for those replacements—and you'll be getting just the right types for the right jobs.

• Ask Your Jobber . . .

Ask him for AEROVOX motor-starting capacitors. He either has them or can get them for you. Ask for the latest Aerovox Catalog. Or write us direct.

AEROVOX
Capacitors
INDIVIDUALLY TESTED

AEROVOX CORP., NEW BEDFORD, MASS., U. S. A.
In Canada: AEROVOX CANADA LTD., HAMILTON, ONT.
Export: 13 E 40 ST. NEW YORK 16, N. Y. Cable: ARLAB

be used by General Electric for the manufacture of fluorescent ballasts.

James A. Comstock, vice president of Acme Electric, together with the managerial and engineering personnel has moved to Cuba, N. Y.

Acme Electric also announces the establishment of a branch factory at Allegany, N. Y., which was formerly a branch of Electrical Reactance Corp.

Charles B. Pickering, formerly industrial application engineer in Connecticut for five years and more recently field engineer on radar equipment for the Bureau of Ships at Charlestown Navy Yard, Boston, has recently joined the Allen-Bradley Boston office as sales engineer. He will serve the New England territory as application engineer for solenoid motor controls.

Major E. J. Collins has returned from the Army Air Corps to Hatheway and Company, Jersey City, as sales manager of Mell-O-Chime door chimes. Hatheway and Company act as national sales representatives for the Mell-O-Chime and Signal Corp. of Chicago.

Anthony L. McCabe announces the formation of McCabe Lighting Corporation, 172 Newbury Street, Boston, Mass. Mr. McCabe recently disposed of his interest in Litecontrol Corporation in order to more fully devote his energies to the design of specialized lighting and the production of custom-built equipment.

American Phenolic Corporation, Chicago is building a new three story and basement building. The new building, adjacent to the main plant, will be used exclusively for the production of plastic items both for the electronic trade and other industries.

After three years' service with the Armed Forces, Lt. Harry C. Dever is back with the Glassport, Pa., division of the Copperweld Steel Company. He will be in charge of the Atlanta office and cover the states of Georgia, Florida, South Carolina and North Carolina.

Charles H. Morse III has been elected vice president of Fairbanks, Morse & Co., Chicago. Mr. Morse will be in charge of research patents, traffic, the company's western pump division and the Inland Utilities Co. His headquarters will be in Chicago.

SIMPLICITY PLUS! New NON-INDUCTIVE CABLE RACK

for
INDUSTRIAL
PLANT
WIRING



Type D-F 3-Conductor Cable Rack, New Non-Inductive Design. Racks available for Cable sizes from 5/16" to 2 3/4".

• Radically different, the new M. & W. Non-Inductive Cable Rack is designed for A.C. or D.C. systems. Racked cables only partially surrounded by metal eliminates any chance of induced current in the rack. Impedance reduced with cables mounted in delta formation. Rack of one-piece construction . . . installation of cables made quick and easy through the use of split bushings.

Send today for Bulletin C-5-51 which illustrates the complete line

**THE M. & W. ELECTRIC
MANUFACTURING CO., INC.**
EAST PALESTINE, OHIO

The "ONE-MAN" HAMMER
For TEN-MEN'S WORK

SYNTRON

DEPENDABLE

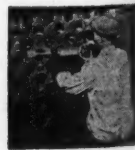
**ELECTRIC
HAMMERS**

Can SAVE You—

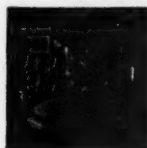
\$4.00 every hour they're used
—that amounts to \$160,000 per week.



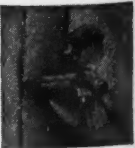
DRILLING



SCALING



REDRESSING



CUTTING

Write for illustrated folder

SYNTRON CO.

690 LEXINGTON HOMER CITY, PA.

The Standard Transformer Company of Warren, Ohio is now represented in Northern New York State by the firm of Hunter and Bell. Offices are located at 259 Delaware Avenue, Buffalo and 625 Cumberland Avenue, Syracuse, with Fred L. Grant in charge of the Syracuse office. They will serve all of Upper New York State, north and west of Albany.

The Russell & Stoll Company, Inc. of New York have appointed the firm of Wagner-Green as their representatives in Northern Ohio.

Reliance Electric & Engineering Company, Cleveland, has announced the appointment of Harold J. Thompson as district manager in Gary, Ind. He will serve the industries of the Calumet and Northern Indiana districts, and will make his headquarters in the Gary National Bank Building.

Jack Beebe will have charge of the manufacturing and distributing of the "S-N-C" transformer division of the Swain Nelson Company, Glenview, Ill.

The Lincoln Electric Company, Cleveland, Ohio has announced election of H. F. Kneen as vice president in charge of manufacturing and G. G. Landis, as vice president in charge of engineering.

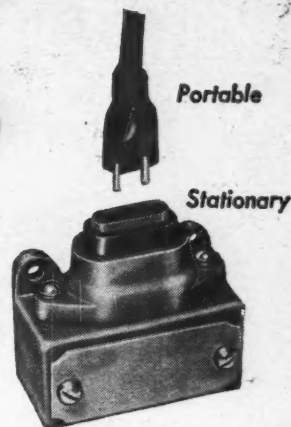
Alreon Manufacturing Corporation has announced the acquisition of the Lewis Electronics, Inc.

National Electric Products Corporation, Pittsburgh has named George W. Hartner sales promotion and advertising manager.

Ilg Electric Ventilating Co., Chicago, has announced two new additions to the sales staff. R. E. Pauling has been named manager of the Tulsa, Oklahoma office and Marion A. Elliott has been appointed to the staff of the Detroit, Mich. office.

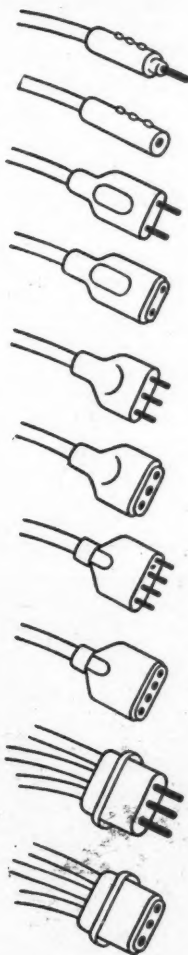
The Lau Blower Company has acquired a new building in Dayton, located five blocks from their present plant.

MINES Cable Connectors



Portable

Stationary



FOR POWER TRANSMISSION

SINGLE OR MULTI-CONDUCTOR

HEAVY DUTY

WATER SEALED

MOLDED RUBBER OR SYNTHETIC

CAN BE MOLDED AT FACTORY
TO SPECIFICATIONS ON YOUR
CORDS OR CABLES

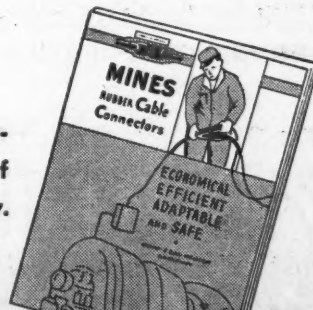
STAND ROUGH HANDLING AND
DIFFICULT CONDITIONS

CAPACITIES FROM 5 TO 500
AMPERES

VOLTAGES UP TO 5000


CARRIED IN STOCK IN STANDARD
DESIGNS AND SIZES AND CAN BE
MADE UP SPECIAL TO MEET YOUR
SPECIFIC REQUIREMENTS

Write for Bulletin MC-106, showing many successful applications of Mines Connectors throughout industry.



MINES EQUIPMENT COMPANY

4231 Clayton Avenue • St. Louis 10, Missouri



You can use THIN-WALL Tubing—

—at ANY outlet of ANY
Kondu fitting.

Just slip out one bushing
and slip in another. No
extra pieces are needed.

Every Kondu box is a union,
and can be taken out of
the line without disturbing
conduit.

Practically unbreakable,
Kondu fittings are 100%
re-usable. Self-aligning ...
vibration-proof.

Write for the Kondu catalog.

KONDU CORPORATION
Erie, Pa.

KONDU MFG. CO. LTD., Preston, Ontario

KONDU



The Threadless Fitting Line
of Unequalled Variety



Slimline Sells Sporting Goods

[FROM PAGE 61]

moved for cleaning or access to the
fixture wiring and auxiliaries. An
aluminum frame, hinged to the fixture
body, supports the metal louvers,
painted flat white. Similar design
features apply to the surface type units
also.

The ballasts for the show case light-
ing units are mounted to a metal en-
closure which projects above the case
top where adequate ventilation is as-
sured.

The Wiring System

The wiring system, is the conven-
tional radial distribution type. The
existing 200-ampere service was re-
placed by a 600-ampere unit to serve
the combined light and power load.
Service throughout the building is
120/208-volt, 3-phase, 4-wire. Light-
ing is balanced on the three phases
with the line side of the fixture auxil-
iaries connected to the 120-volt circuits.
Voltage on the lamp side of the bal-
lasts is 700 for starting and 290 for
operating the lamps.

Circuits from the distribution panels
are installed in thin-wall conduit to
accessible connection boxes adjacent to
fixture locations. Flexible conduit



*The Twenty-First Annual Meet-
ing of the Eastern Section, IAEL,
held at Hotel New Yorker, New York
City, on October 22-24, was opened
by its President, G. S. Casterline,
who outlined activities over the past
year and pointed up responsibilities
and program ahead.*

There Is A Profit For YOU In Automatically Turning ON and OFF ELECTRIC SIGNS— LIGHTING SYSTEMS

And Dozens of Other Applications
with the

**2200-Watt AUTOMATIC
Self-Starting TIME SWITCH**
Single Pole—Model 120

\$12.00

Why buy LESS

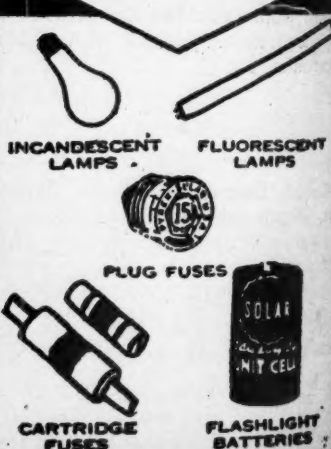
when you get the MOST
in AUTOMATICS

Prices Subject to Usual Discount & Terms

Write for Information

AUTOMATIC
Electric Manufacturing Co.
TIME SWITCHES—FLASHES
MANKATO • MINNESOTA

SOLAR Electrical Products



Quotation on request

**SOLAR ELECTRIC
CORPORATION**

WARREN, PENNSYLVANIA

jumper in the suspended ceiling connect the fixture housings to the boxes.

According to the electricians on the job, the large slimline fixtures were easy to install. When the new ceiling was suspended, substantial wood frames were installed to house the recessed units. The large fixture trough is simply inserted in the ceiling opening (two men can easily handle the unit) and the metal sides attached securely by screws to the wood frame which supports the entire weight of the fixture, thus relieving the electrical connections of all tension. Fixtures, in general, are controlled in groups from distribution panels at convenient locations on each floor. Fixtures came to the job completely wired.

One unique feature is the time clock control of the main floor panel, designed so that any desired number or group of lighting fixtures can be left burning at night and be turned off at a predetermined hour. The hot legs of the 4-wire service to the panel go through a 3-pole magnetic contactor whose solenoid is operated by a time clock circuit. A single-pole toggle switch in parallel with this control circuit is located at the front entrance to the store. Upon leaving the store at night, this toggle switch is flipped to the "off" position and the clock is in the circuit, controlling the entire panel and all the circuit switches left in the "on" position. The first person to open the store in the morning turns the toggle switch "on" and this cuts out the time clock control of the magnetic contactor and returns the panel to service again. The flexibility of this system lies in the fact that no specific number of units are permanently under time clock control. Depending upon the "night display lighting" plans of the owner, either one, a dozen, or all the switches on the main floor panel can be placed under this control.

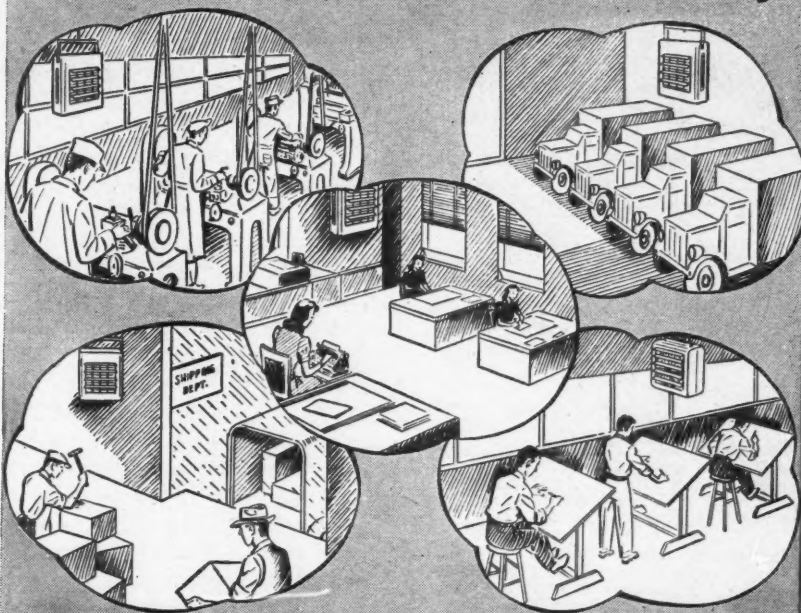
Other Electrical Features

Intelligent application of electrical equipment in this store is not confined to lighting alone. Other features installed for customer and personnel comfort and health, and for more efficient operation include:

Germicidal Lamps—These units are installed in all washrooms, rest rooms, locker rooms, and passenger elevator.

Air Conditioning and Cleaning—The entire building is air conditioned. Installed with this system is a Precipitron unit which electrostatically cleans all air circulated in the building. It is estimated, this installation will save

HEATING WHERE YOU WANT IT Quickly . . . Economically



With ELECTROMODE



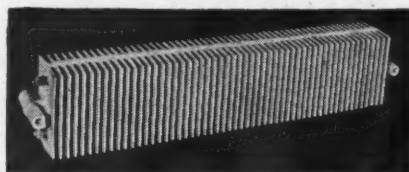
This type Electromode (from 10 to 60 KW) is for suspension mounting only; other models (1.5 to 7.5 KW) for either suspension or portable mounting.

All-Electric Unit Heaters

Have clean, low cost, healthful warm air in a minute, anywhere desired . . . in stockrooms, factory areas, warehouses, foundries, isolated buildings, exposed areas, or any section extended beyond installed heating range. Improve efficiency, increase output and guard your employees' health with Electric Unit Heaters. There are no exposed glowing resistors, no incandescent hot wires with Electromodes, yet all the electrical energy is converted 100% into heat, distributed by means of fans and deflectors.

Electromodes owe their great efficiency, long life, freedom from fire or explosion hazard to the special patented heating element. Sheathed elec-

tric resistors are cast into and completely embedded in a one-piece finned aluminum casting. Since the fins are an integral part of the casting, there are no dead air spaces to hinder the efficient operation of the grid. Due to the exclusive one-piece design, durable construction and large convection surface, Electromode Unit Heaters have high B.T.U. output at a safe, low operating temperature.



Patented Heating Element . . . No hot wires or glowing resistors. The sheathed resistors are cast in a one-piece finned aluminum casting.

EASY TO INSTALL

No expensive piping or piping connections are required. Electromodes are quickly installed—wherever circuit wires can be run. They are easily removed and relocated as the need develops. Simple to control and economical in operation, Electromodes are made in a wide range of capacities to meet a variety of requirements.

Send for latest Bulletin 45-U and Heating Analysis Survey Form.
ELECTROMODE CORPORATION, Div. of American Foundry
Equipment Co., 434 So. Byrkit Street, Mishawaka, Indiana.



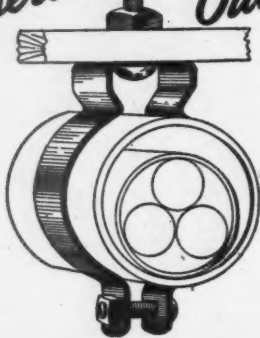
ELECTROMODE

Electric Unit Heaters

MINERALLAC

Steel HANGERS, CLIPS, STRAPS

Outserve! Outlast!



Minerallac Cable, Conduit and Messenger Hangers are STEEL. Easier, quicker to install; permit speedy, compact wiring; economical. Also in Everdur . . . Porcelain Insulating Bushings available.

Jiffy STEEL Clips (Pipe-clamp) require only one screw, nail or bolt; rib-strengthened; for hanging pipe, conduit, BX cable, mounting coils, etc. Millions in use.

Steel Straps for Messenger-cable services on outlet boxes; may be used in conjunction with hangers.

Order from your Electrical Wholesaler. Send for literature.

MINERALLAC ELECTRIC COMPANY
25 North Peoria Street Chicago 7, Illinois

BETTER LIGHTING IS A NATURAL RESULT WITH MULTI

Reflectors



• All time favorites . . . that's the way contractors feel about the MULTI line. They have good reason too—MULTI is complete—they can get the proper unit for any type of installation—maintenance is simple—no after worries. Here is your modern, flexible line of Reflectors that give long-time service and better lighting.

• Send for Complete Catalog

MULTI

ELECTRICAL MANUFACTURING CO.
1840 W. 14th ST., CHICAGO, ILL.

the services of one janitor per year, reduce lighting maintenance and interior decorating costs, keep stock clean, and eliminate the prevalent practice of selling soiled merchandise at a loss.

Complete Intercom System—Considerable time, effort, and "running around" is saved by the installation of a complete intercommunicating system with master stations in each executive office; buyers offices; stock, shipping and receiving departments. One unique feature of the setup is the two-way unit in the truck alley with switches to contact either the receiving or shipping departments. The driver merely flips the proper switch, announces his arrival with a delivery or for a pick-up and he is immediately accommodated.

There may be a tendency on the part of some to consider the electrical installation in this store as somewhat gold-plated—embellished with a lot of impressive sounding gadgets. Compared with past standards, in general, this may have some foundation. Business and scientific development and progress go hand in hand. The astute merchant is learning to utilize technological developments to his own advantage. Each feature outlined above was installed purely on the merits of its functional value—the *planned lighting* pays dividends as a merchandising tool; the air cleaning system definitely reduces operating costs; the intercom system promotes office efficiency; the air conditioning and germicidal units add to the comfort and morale of customer and employee. We have, in this installation, a model example of what electrical accessories can do for the commercial business establishment.



E. E. Larson, Riverside city electrician, S. W. Section President, H. L. Gerber, S. W. section Secretary Treasurer and J. J. Siddall, H. H. Robertson Co. at the San Francisco meeting of the IAEI.

It's YOUR future— Make the most of it!

**Start now to earn
the bigger pay in
electrical repair**



Was there ever such an opportunity to get started in electrical maintenance and repair—and at top-notch wages? Are you ready—with experience and ability—to cash in on it? Others are getting just the sort of background needed—quick! practical!—to handle the great variety of electrical maintenance and repair work TODAY—from this well-known electrical library. You can too!

Electrical Maintenance and Repair Library

5 volumes, 2042 pages, 1721 illustrations

Gives you the "know-how" to tackle any wiring or motor job. Five books show you HOW—to install all types of motor and generator units—to inspect and repair motor starters and generators—to diagnose motor and generator troubles—to figure new windings for old cores, DC and AC windings—to test armature windings, test induction motors, etc., etc. The new book is full of trouble-shooting charts that show quickly symptoms, causes, specific remedies, etc.

Includes trouble - shooting book

Now in addition to four well-known practical books on all details of testing, connecting, rewinding, installing and maintaining electrical machinery, the Library includes Stafford's *Troubles of Electrical Equipment*, a handy book giving helpful maintenance information, special trouble-shooting charts, explanations of symptoms and causes of machinery troubles, specific remedies, etc. This new library gives you the ability to handle bigger jobs with surety of results.

10 DAYS' EXAMINATION

Easy monthly payments

We want you to examine this Library for 10 days. If you don't want them at the end of that time, there's no obligation to keep them. On the other hand if you think you want the help these books can give, start the small monthly payments then, and in a short time the books are yours, right while you have been using them. Send the coupon today.

EXAMINATION COUPON

McGraw-Hill Book Co., 330 W. 42 St., N.Y. 36, N.Y.
Send me Electrical Maintenance and Repair Library, 5 monthly payments then, and in a short time the books are satisfactory, I will send you \$1.00 in 10 days, and \$1.00 a month until \$15.00 has been paid. Otherwise I will return the books postpaid.

Name
Address
City and State
Company
Position
In Canada: Mail to Embassy Book Co., 18 Richard St., Toronto 1.

Tolerance Control Through Electronic Timers [FROM PAGE 63]

grind and closing it for the finish grind. The second relay is in the grinding feed motor control circuit (Fig. 3 and 4) automatically feeding the grinding wheel into the bearing race and retracting it for each operation. The speed of this d-c motor is manually controlled by suitable rheostats. Other motors on the grinder are controlled through suitable relays in a sequence control panel at the base of the unit (Figs. 5 and 6).

Experience with vacuum tube control on these Van Norman radius grinders has indicated a reduction of approximately 50 percent in rejected parts (those with either too small or too large a radius in the bearing race). Maintenance also has been considerably reduced. A monthly checkup is made on each machine (about 40 radius grinders now have vacuum tube control) at which time all relay contacts are cleaned, circuit wires checked for loose connections and oil seepage, and vacuum tubes checked and tested (Fig. 7). Under wartime operation averaging twelve hours per day, six days per week, the tubes lasted from eight months to a year. Normal peacetime schedules would probably prolong tube life. Chief electrician Franklin G. Koch keeps the machines in A-1 operating condition. Numbered among his instruments for testing are the following: A voltmeter, ammeter, milliammeter, vacuum tube tester, and tester for condensers. Machine breakdowns have been practically unknown, with none that occurred attributed to electrical control failure.



Trouble-free operation of the electrical system of the Food Machinery Corp., Hoopston, Ill., is the responsibility of maintenance electricians R. A. Peterson (left) and Lyle D. Miller.

INTER-MATIC



TIME SWITCH

OPENS
UP A BIG

**NEW MARKET
BECAUSE IT IS SOLD
AT A PRICE MORE
PEOPLE CAN AFFORD**

\$7.50

Write to
Dept. 12EC for
catalog and near-
est distributor

LIST F.O.B. CHICAGO
115 V., 60 CYCLE

FEATURES

Switch Rating: 35 amperes at 115 volts. Single pole only.
Timing Motor: Synchronous. Self starting. Fully enclosed. Permanently lubricated.
Manual Control: The switch may be turned "on" or "off" manually whenever desired irrespective of the time settings.
Automatic Reset: Regardless of whether the switch has been turned "on" or "off" manually, the time cycle is always resumed automatically.

Accessibility: Entire mechanism may be removed by loosening one screw. Motor, switch, terminal block, etc., easily replaced.

Safety: Listed by Underwriters' Laboratory Re-examination Service.

Guarantee: One year guarantee against defects in workmanship and material.

Manufacturer: Established 1891. Manufacturers of the Cutawl, fare registers, coin meters, range timers, etc.

USES

Signs • Store Window Lighting • Night Lights • Flood Lights • Apartment Hall, Lobby, Stairway and Yard Lights • Room Coolers • Attic Fans • Stokers • Oil Burners • Gas Burners • Pumps • Poultry House Lights.

INTERNATIONAL REGISTER CO.

2620 W. WASHINGTON BLVD., CHICAGO 12, ILL.

The Jiffy Line

CELEBRATES ITS 30th ANNIVERSARY 1915-1945



"JIFFY"

SNAPIN BLANKS

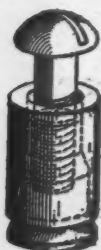
"Jiffy" Knockout Seals are safe, cost less and are easy to install. Only one piece, they snap into place. No tools necessary.

"Jiffy" ADJUSTABLE HOLE CUTTER
"Jiffy" Conduit Bender
"Jiffy" SOLDER DIPPER

Write for "Jiffy" folder EC for full details.

CLYDE W. LINT CO.

Room 301, 100 So. Jefferson St.
CHICAGO 6, ILLINOIS



CHICAGO EXPANSION NUTS

The Dependable Machine Screw Anchors

For machine screw or machine bolt anchors, it will pay you to specify Chicago Expansion Nuts. These dependable anchoring devices offer the following advantages:

1. Quickly installed—a few hammer taps sets them.
2. Work can be easily dismantled.
3. No part of the anchor projects after removal from floor or wall.
4. Large stock—IMMEDIATE DELIVERIES.

Chicago Expansion Nuts have standard machine screw threads. Available in all sizes from No. 6 up to and including 3/4". Setting tool free of charge.

IMMEDIATE DELIVERIES

Write for New Catalog or call your wholesaler.

CHICAGO

CHICAGO EXPANSION
BOLT COMPANY

2231 W. Ogden Ave. • Chicago 12, Ill.

NECA Convention Report

[FROM PAGE 53]

ture. It covers many new phases of farm wiring not previously covered, such as wiring for sweet potato storage, tobacco curing, usual poultry and dairy wiring, etc., said Mr. Brand.

Sponsored by five major trade associations in the electrical industry, the National Adequate Wiring Bureau was organized in 1938 for the purpose of assisting, in every possible way, to spread the "gospel" of adequate wiring installations in the homes of America, S. J. O'Brien, NECA representative on the NAWB, told NECA members. The sponsors are: Edison Electric Institute, International Assn. of Electrical Leagues, National Electrical Manufacturers Assn., National Electrical Wholesalers Assn., and the National Electrical Contractors Association. The program is carried out through over 200 local groups of electrical leagues and electric utility companies, Mr. O'Brien said, and has consumer interest uppermost.

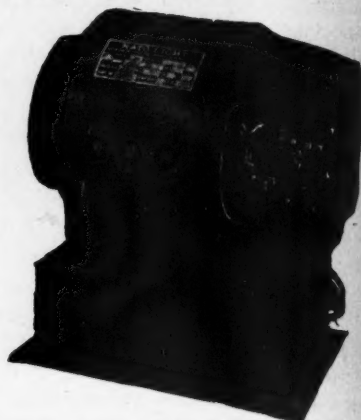
"Every branch of the electrical industry will benefit from the NAWB program" Mr. O'Brien stated, "but no other branch is in a position to receive more direct benefits than the electrical contracting industry." He warned, however, that there will be tremendous competition between the various branches of the construction industry for the home builder's dollar in the building boom era upon which the nation is about to enter. NAWB is telling the public and all who are interested in home construction why a little more money must go into the electrical contract if the home is to meet its



NECA Chapter Managers E. H. Hersberg, Milwaukee, Wis. Chapter; Temple Wheeler, South Texas Chapter, San Antonio, Texas.

110-Volts A.C. from Direct Current

with KATOLIGHT ROTARY CONVERTERS Change 32, 110 or 220 volts D.C. to standard 110-volt, 60-cycle A.C. for operating radios, electronic & sound apparatus, electric signs, A.C. appliances, etc.



KATO ROTARY KONVERTER, 225 Watts. Pioneers in the Building of Small Rotary Converters. Special motors and generators 25 to 800 cycles.

Also manufacturers of A.C. and D.C. generators ranging from 350 watts through 25 K.W.; power plants; Frequency Changers; and Motor Generator Sets.

KATO ENGINEERING CO.

650 N. Front St., Mankato, Minnesota

HEAVY DUTY Carbon Lamps

FOR INDUSTRIAL USE

• Recommended for use where Long Life is essential, where Vibration is excessive, where Inaccessibility of lighting fixtures makes Replacement Difficult, where a Pilot Light is needed.

Available in a wide variety of sizes, shapes, candle power and voltages—standard and candelabra bases.

A large supply of all standard types are carried in stock, thus assuring you prompt service at all times. Write for catalog sheet 1-2 for full details or see your Electrical Wholesaler.

**NORTH AMERICAN
ELECTRIC LAMP CO.**

1044 Tyler Street, St. Louis 8, Missouri

electrical needs, Mr. O'Brien stated. This is done through consumer education literature, such as the booklets "Electrical Guide to the Postwar Home" for new houses, and "Vitalize Your Home" for existing homes.

Reviewing opportunities and problems facing the electrical contracting industry today, Joseph D. Keenan, Vice Chairman for Labor Production, War Production Board, said the industry "stands on the threshold of unprecedented prosperity and opportunity to serve, and with its unmatched record of social consciousness should be able to cope with the puzzling new problems of atomic power, prefabrication and electronics."

Mr. Keenan said that extensive electrical installations will be required by industry expanding for peacetime production, and predicted that residential construction will become more and more an important part of the work of electrical contractors. He presented in general an encouraging and optimistic outlook for the electrical contractor, but cautioned that the time will come when the present pent-up demand will be satisfied. He urged the industry to seek new fields and constantly improve its products and services. Prices must be kept low and in line with actual cost, he said, and placed an equal responsibility on labor and management in this task.

The overall volume of construction for the fourth quarter will be ten percent higher than if the war had continued, Mr. Keenan estimated, and said the 1946 rate is expected to rise more than 40 percent above the 1945 level. He assured there seemed to be no major shortages of electrical materials, fixtures and wiring devices, but said shortages of some construction materials such as lumber and brick might retard electrical construction.

Mr. Keenan asked the cooperation of the industry in working with government to smooth out the peaks and valleys of building activity, in operating at peak efficiency, and in price stabilization for homes.

A film describing lamp production and research was shown by W. H. Robinson, Jr., Manager, Advertising Division, Lamp Department, General Electric Company, Nela Park. Mr. Robinson then presented a sales program designed for the electrical contractor covering the retail store lighting market. Much statistical information was given, which indicated that the market ahead is unprecedented, there is danger of underselling it, and that the store owners want fluorescent lighting.

FULLMAN

Latrobe
PRODUCTS



★ FLOOR BOXES ★

★ WIRING SPECIALTIES ★

Check Frequently Your Stock of Latrobe Products

Reconversion is making necessary a great amount of reconstruction and plant readjustments. Quickly installed Latrobe Products not only save time and labor on such projects but do a thoroughly dependable job.



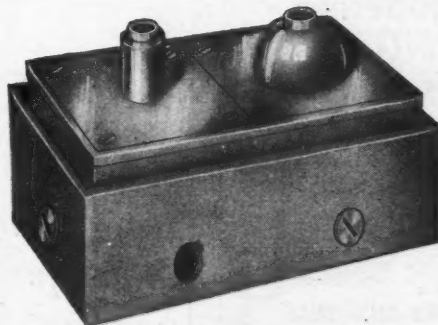
NO. 110 NON-ADJUSTABLE WATERTIGHT FLOOR BOX

The body is of iron with 3½ in. round brass cover plate. Shown here with No. 208 Receptacle and No. 207 Bell Nozzle.



NO. 280 NOZZLE WITH NO. 200 COVER PLATE

This is a ten amp. 250 volt receptacle in brass housing, ½ in. brass extension.



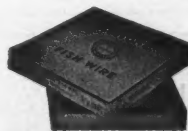
ADJUSTABLE GANG BOX

These Gang Boxes have solid partitions to separate high and low tension wires. Box bodies are 3 in. high, height to top of cover plate 3½ in.



"BULL DOG" INSULATOR SUPPORT

Convenient and secure for fastening porcelain or glass insulators to exposed steel framework.



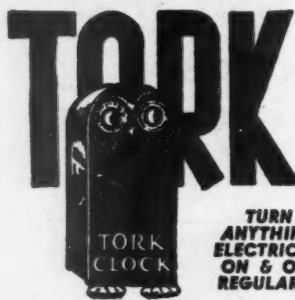
KEYSTONE FISH WIRE

Finest grade flat steel wire. Ten sizes. Coils from 100 ft. up.

FULLMAN MANUFACTURING CO.
LATROBE . . . PENNSYLVANIA

WHERE TO BUY

Equipment, Materials and Supplies for
Electrical Construction — Maintenance — Repairs



The TORK CLOCK CO., Inc.
MOUNT VERNON, NEW YORK

TURN
ANYTHING
ELECTRICAL
ON & OFF
REGULARLY

Speed Reconversion

with a



A Pusher . . . A Puller
A Reel . . . A Fish Tape
The fish tape is pushed, pulled,
wound and unwound by simply
pumping the handle. One man
can pull as much as three with
the Kuehl Fish Tape Gun. It
offers a 3 to 1 mechanical
advantage.
Write for descriptive bulletin.
D. S. KUEHL & SON
Clio Michigan

KUEHL
FISH
TAPE
GUN



for SODERING
Silver Sodering
WELDING

L. B. ALLEN CO., INC.
6715 Bryn Mawr Chicago, 31, Ill.

Burned Out or Broken Electric Heating Elements



repaired with NICHRO-
CITE PASTE. Simply
overlap ends, apply paste,
turn on current. Used by utility com-
panies, etc. Family size, \$1.00. 4 oz.
size \$2.50. Satisfaction guaranteed.

ARMSTRONG Mfg. Co., Box 881 F, Minneapolis, Minn.

for PROMPT ANSWERS

to business
problems

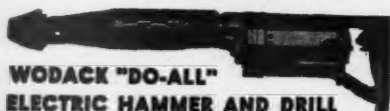
USE THE
SEARCHLIGHT
SECTIONS OF

Air Transport
American Machinist
Aviation
Aviation News
Bus Transportation
Business Week
Chemical & Met. Engineering
Coal Age
Construction Methods
Electrical Contracting
Electrical Merchandising
Electrical World
Electronics
Engineering News-Record
Engineering & Mining Journal
F & M J Market
Factory Management & Maint.
Food Industries
Power
Product Engineering
Textile World

Departmental Staff

McGraw-Hill Publishing Co., Inc.
330 W. 42nd St. New York 18, N. Y.

DRILL CONCRETE THE EASY WAY



WODACK "DO-ALL"
ELECTRIC HAMMER AND DRILL

Saves time and labor installing expansion anchors.
Two motions—rotated for hammer drilling—re-
tary for twist drilling. Drills masonry to 1 1/2" dia.,
metal 3/4". Easy to maintain. Universal motor, runs
direct from lamp socket. Weighs 15 lbs. Star drills
in 17 diameters. Also chisels, bull points, etc. Ask
for bulletin.

Wodack Electric Tool Corporation
4628 W. Huron St. Chicago 44, Ill.
Telephone AUstin 8866

LAMP ANNUNCIATORS

Kirkland Bulls-I-Units are ideal
for building lamp annunciators.
Just provide the proper size holes



in the
panel, then
insert the
Kirkland
units and
lock into
place. As-

sembly is then ready for installa-
tion. Connect incoming wires and
place in service.

Write for Catalogue
THE H. N. KIRKLAND CO., MORRISTOWN, N. J.

The day's business session closed with the announcement of the result of the election of NECA officers.

Robert W. McChesney, of Harnett Alexander, Inc., Washington, D. C., was reelected President. L. T. Allen, Allen Electric Company, Tulsa, Okla., was elected Vice President for Division 5, and Leo L. Rosenberg, T. L. Rosenberg Co., Oakland, Calif., was elected Vice President for Division 6.

WEDNESDAY, OCTOBER 31

The annual meeting of the IBEW Employers Section, formed third day session of the NECA program. Also subjects relating to labor-management and problems involving electrical workers were combined to form this session.

E. C. Carlson, IBEW Employers Section Chairman, and Labor Relations Committee Chairman, opened this session with a short history of IBEW, its organization and operation, and a review of its past activities and future objectives.

The value of local labor-management leadership was stressed by Ed. J. Brown, International President IBEW. He called on the electrical contracting industry to develop a wider application of labor and management cooperation between each local union and local chapter of NECA. Praising the pattern of labor-management cooperation developed during the past generation between NECA and IBEW, national associations, during which time there has been no serious strike in the industry, he said the local cooperation can and must be effected. "This high



Louis Horacek, Horacek-Hayden, Inc., Rochester, N. Y.; Emil Preiss, NECA Division 1 field representative, New York City.

a close degree of national cooperation should result one extended to all local unions and chapters," he said. Mr. Brown pointed out that IBEW and NECA achieve co-operation and harmonious relations because their objectives are the same—improving the industry and serving the public better.

Need for skilled mechanics to handle electrical installations for the coming building boom demands immediate organization and putting into action of more local Apprenticeship Committees, warned Gordon M. Freeman, International Vice President of IBEW. Time for training workers is fast running out, he declared, and gave as reason the urgency the necessity to develop programs and policies that will attract a large number of veterans into the electrical industry. He described apprentice training in the electrical industry as a joint IBEW and NECA endeavor with national standards regarded as a model for any apprenticeship program.

Mr. Freeman predicted a greater demand than ever for skilled journeymen to handle the mammoth electrical installation and maintenance job ahead. Both quantity and quality will be demanded, brought about by the unprecedented construction program and the adaptation of war-hastened electric developments to peacetime uses. Placing the rapid development of the field of electronics, with all the marvels of radar, and the thousands of other applications of the vacuum tube, second only to development of the atomic bomb, he predicted new uses for electric power, and the opening up of a whole new technical field. These new fields, requiring new knowledge and new skill, will require specially trained men if they are to be efficiently and well handled. Mr. Freeman pointed out that 99 percent of the men in the armed forces have had mechanical training of some sort, which gives them a wonderful background on which to progress rapidly and to go far in mastering the necessary skill, gain competence and be ready for the job ahead. Systematic training through apprenticeship offers a sound solution to this problem, he declared.

Results of tests for new employees during the war confirms the value of training, he said, and cited grading of applicants seeking union membership in order to work in the Oak Ridge atomic bomb project as an example. Average grade was 37, yet a group of applicants who had taken apprenticeship training courses received grades up in the 80s and 90s. Prompt organization of local Apprenticeship Committees is urgent to get these programs

SMALL DIAMETER, THERMO-PLASTIC INSULATED

FLAMENOL* Building Wire

*For Complete
Wiring Systems*

Use this high quality building wire for new wiring, reconversion wiring or maintenance wiring. It is available in two types in sizes 14 to 2,000,000 CM: Type T for general purpose wiring and Type TW for wiring in wet locations. The small diameter of this wire and its smooth, glossy finish make it easy to pull. Stripping may be done quickly. There is no over-all braid on the wire. Moreover, its small diameter enables more copper to be placed in conduits. The insulation of both Types T and TW Flamenol Building Wire has long life, is high in dielectric and mechanical strength and is resistant to oils, acids and alkalies. Type TW insulation also has a low moisture absorption rate.

FLAMENOL CORD

Here is a good looking, tough, flexible cord you'll like to use. It is available in three types: heavy-duty for severe conditions, medium duty for less severe conditions and rip cord for use on lamps, fans and other small devices.

FOR FURTHER INFORMATION

see the nearest G-E Merchandise Distributor or write for Flamenol Building Wire and Cord folders. Address Section W1251-8, Appliance and Merchandise Dept., General Electric Company, Bridgeport, Conn.

*Reg. U.S. Pat. Off.

TYPE T
for General Purpose Wiring

TYPE TW
for Wiring in Wet Locations

HEAVY DUTY
FLAMENOL
CORD

BUY WAR BONDS AND HOLD THEM

GENERAL  ELECTRIC

Test-O-Lite

TESTS ANY VOLTAGE...
100 to 550 Volts, A.C. or D.C.
—Safely, Swiftly, Surely



THE NEON GLOW LOCATES TROUBLE INSTANTLY

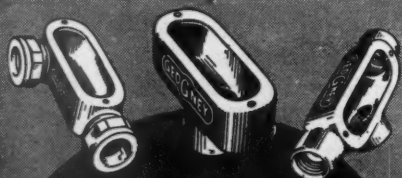
Indicates hot or grounded wires. Tells AC from DC. Far superior to ordinary clumsy test bulb. Indispensable in shop or home. The only pocket-size tester with **PATENTED SAFETY FEATURE**. Lifetime guarantee. List \$1.50. Purchase thru regular electrical dealers. Pat. No. 1,778,883.



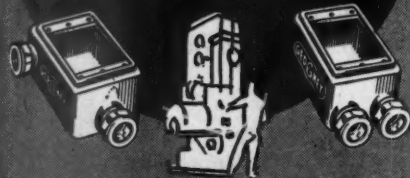
For Quick Soldering

A small quantity applied to the joints to be soldered will, WHEN HEATED, flow and unite the parts the same as wire and bar solder. No flux or soldering iron required. (Priority A-7 or better) 25c tubes; 1, 5, 10 and 25-lb. cans.

L. S. BRACH Mfg. Corp.
55-63 Dickerson St. Newark, N. J.



GEDNEY GEDNEY FITTINGS...FIT! FITTINGS



GEDNEY Fittings and Conduit Bodies are rigidly inspected; cleanly finished and carry the approval of Underwriters Laboratories. They are carefully packed in metal-edge cartons, convenient quantities, clearly labeled. Wholesale distribution only. Write for catalog.



**GEDNEY ELECTRIC
COMPANY**

RKO BLDG. RADIO CITY NEW YORK N. Y.

going, before it is too late, he said.

Pointing out the advantages to the electrical construction industry in properly retiring its workers, G. M. Bugnizet, IBEW International Secretary outlined in detail an IBEW proposed industry-wide pension plan. "Proper care of workers in an industry is an industry matter" he declared.

The present IBEW security plan was reviewed in detail. It now provides that every member reaching the age of 65 years, who has 20 years good standing in the union, may be retired from the trade at \$40.00 per month pension, plus other benefits of maintenance of standing in the union at no cost, funeral benefits, etc. Assessments upon individual members, set up in 1928, are at very low rates, it was revealed. "We embarked upon our pension plan with more faith than actuarial accuracy," admitted Mr. Bugnizet.

It was pointed out that a principle of insurance is, that if the base is widened, more people can be served more stably. Officers of NECA some time ago were invited to discuss this problem with a committee from IBEW's International Executive Council. As a result of these meetings an agreement was reached upon a plan which was presented to the NECA membership at this convention.

Meeting in closed session, the NECA membership approved in principle an Employees Benefit Agreement which gives industry-wide support to the IBEW-developed and sponsored pension plan. By resolution, introduced by Lester F. Brooker, the Labor Relations Committee was authorized to negotiate such an agreement with the IBEW, subject to NECA Chapter ratification by a mail ballot. The ballot is to be taken within 60 days. By resolution also, the Labor Relations Committee was authorized to make such revisions in the text as may be recommended by legal counsel or required by governmental agencies, provided the proposed payroll assessment and other fundamentals of the proposed agreement are not changed. Payroll assessments in the proposed agreement are to be an amount equal to one percent of the gross labor payroll paid to members of IBEW. This fund will supplement the pension benefit fund of IBEW which has been in existence 18 years.

This plan, philanthropic and social in nature, will cost much less than similar plans in force in individual companies it was claimed, and cost of administration will be kept at a minimum and will be borne almost entirely by local Chapters of NECA.

SEARCHLIGHT SECTION

(Classified Advertising)

Employment • Business

Equipment (Used or Resale)

"OPPORTUNITIES"

UNDISPLAYED RATE

(Not available for equipment advertising)

15 Cents a Word. Minimum \$3.00. POSITIONS WANTED (full or part time individual salaried employment only), 1/2 above rates, in advance. BOX NUMBERS—Care of publication New York, Chicago or San Francisco offices count as 10 words.

DISPLAYED RATE

Rate: \$8.50 per inch for all advertising other than contract. Contract rates on request. AN ADVERTISING INCH: 1/4" on one column, 3 columns—30 inches to a page. E.C.

SELLING OPPORTUNITY WANTED

ESTABLISHED REPRESENTATIVE, full time, for sales of electrical materials in Philadelphia territory. Please advise products and coverage desired. Frank B. Forrest, Braking Hall, Haverford, Pa.

LT. COL. Signal Corps being discharged. Former general sales mgr. for South's largest industry. Excellent record and references. Desires lines as manufacturer's representative in Southeastern states. Atlanta headquarters. RA-358, Electrical Contracting, 520 N. Michigan Ave., Chicago 11, Ill.

LINES WANTED

By Los Angeles manufacturers' representative with over 25 years' experience in the sale of electrical wiring, supplies, construction materials and lighting equipment.

RA-356, Electrical Contracting
520 N. Michigan Ave., Chicago 11, Ill.

AVAILABLE

15 yrs. experience in fractional and industrial electric-motor repair, and maintenance; in large industrial-plant. Would like to contact manufacturer or distributor requiring the services of a field-man; or has a sales and service territory open, in the central or eastern states.

SA-357, Electrical Contracting
520 North Michigan Ave., Chicago 11, Ill.

WIRE and CABLE BOUGHT AND SOLD

• Substantial quantities of surplus new insulated copper wire in all voltages and almost any constructions now available.

Send us your inquiries or offerings
UNIVERSAL WIRE and CABLE CO.
2022A WEST MADISON ST. CHICAGO, ILL.

December Special

Three—200 h.p., 60 cycle.

3 phase, 900 r.p.m.,

G. E. Exp. Proof Motors

MOTORS, GENERATORS, TRANSFORMERS BOUGHT & SOLD



For prompt action, wire specifications collect

ELECTRIC EQUIPMENT CO.
63 Curlew Street • Box 51 • Rochester 1, N. Y.

TOOLS: Vise-grips, CeeTee, Waterpump, needlenose, diagonal cutter pliers, crescent wrench, pipe-wrench, plastic screwdriver, clawhammer, hacksaw & 14 pc. socket set 7/16 to 1" including Universal joint & flex handle. Complete 25 piece guaranteed tool kit only \$49.85. Immediate shipment! Catalogue & price list free! Order now!

UNIVERSAL TOOL COMPANY
1527 Grand EC-11 Kansas City, Mo.

How Much Will It Cost

[FROM PAGE 70]

Material	
Purchase price of panel unit (See sheet 3, Fig. 4, light type)	\$18.00 (P)
Fuses	3.25 (F)
Total	\$21.25
Service charges and return—10 percent	2.13
Total	\$23.38
Labor	
Installation cost	\$6.34
Insurances, job costs etc.—20 percent	1.27
Labor job cost	7.61
General office and administrative expenses—15 percent	1.14
Total	8.75
Return—10 percent	0.87
Total	\$9.62
Estimated Sell—Material	\$23.38
Estimated Sell—Labor	9.62
Total	\$33.00 (Bold Type Unit on Sheet 3)

The cost of renewable fuses was used in order to meet the maximum requirements. This is not to be interpreted as an endorsement for the general use of renewable fuses.

Dead Front Panels

Sheet 5, Fig. 6, lists the units for dead front pull-out type panels. This sheet has one table for 250-volt and one for 600-volt units. The arrangement of the tables is similar to that used by the manufacturers for listing the equipment prices. The order of listing is the reverse of that shown for open type panels. Here the mains are listed first.

Again the procedure for estimating is practically the same as for the live front panels, but the selection of units is somewhat different. There are only two types of mains: "lugs only" and "pull out." The latter is seldom specified. The branch circuits for 30-ampere and 60-ampere sizes are figured in multiples of two since this is the usual circuit arrangement in this type of panelboard.

Example IV

Panel Specifications: A 250-volt, 3-phase, 3-wire panel; 600-ampere mains (lugs). Four 30-ampere, four 60-ampere and one 200-ampere pull-out branches. Space only for two 30-ampere and two 60-ampere branches.

ESTIMATE

Using Units from Sheet 5, Fig. 6

	Unit	Extension
1—600-amp. mains (lugs)	\$80.00	\$80.00
2—30-amp. double branch (4 cts.)	19.70	39.40
2—60-amp. double branch (4 cts.)	34.00	68.00
1—200-amp. single	59.00	59.00
1—space—(two 30-amp.)	6.50	6.50
1—space—(two 60-amp.)	11.00	11.00

Estimated Selling Price (installed) **\$263.90**

Determining Base Labor

No base labor is shown in the tables—only base material and installed selling price. To include base labor units would have added one more set of figures to an already complicated table. The base labor can be readily determined by simply subtracting from the selling unit the amount included for material (table units "P" plus "F" plus 10 percent), then dividing the result by 1.518. Or the constant 0.658 (the reciprocal of 1.518) may be used as a multiplier. The mark-ups used for labor (20, 10, and 15 percent) total 51.8 percent. See example III for an explanation of what each mark-up covers.

The following example indicates the method of determining base labor cost from the units shown in the tables on the preceding pages of this article.

Using the selling unit price of \$33.00 for the 100-amp, fused main on a 3-phase, 3-wire, polarity panel (Example III), find the base labor involved in this installation.

$$\text{Material} = [(\text{"P"} + \text{"F"}) + 10\%] = [(\$18.00 + \$3.25) + \$2.13] = \$23.38.$$

$$\text{Total Labor} = (\text{Selling Unit—Material Cost}) = (\$33.00 - \$23.38) = \$9.62.$$

$$\text{Dividing } \$9.62 \text{ by } 1.518 = \$6.34 \text{ the base labor unit.}$$

or

$$\text{Multiplying } \$9.62 \text{ by } 0.658 = \$6.34 \text{ the base labor unit.}$$

This unit covers the complete installation labor (without mark-up) which includes such items as receiving, moving, setting, and making conduit and cable connections. In the preceding article it was stated that labor for connections at distribution centers was not included in the conduit and wire units. For accurate estimating, such labor belongs with the distribution center units.

The next article will be on motor wiring. As the labor for panel and cabinet connections has been included with the panel and cabinet units, the motor branch circuits will not have to carry allowances for such work.



CHECK THESE *Extra* USES for BLACKHAWK PORTO-POWER PIPE BENDERS



Porto-Power Pulls Shafts and Pulleys
The same power unit furnished in the Blackhawk Bender licks these tough jobs easily.



Lift Heavy Machines
Cumbersome machines raised from low of 3½ in. to 8½ in. height—speedily, safely with Porto-Power.



Build Your Own Press
Your Blackhawk Pipe Bender power unit can be used in a press. Free blueprints give you directions.



All-Directional Handy Jack
Porto-Power rams operate at any angle to do 1,001 tough jobs easily, safely and fast! Operator is always safely away from danger zone.

GET all the usefulness out of your Blackhawk Porto-Power Pipe Bender! Sure, it bends pipe up to 4 in. Also, it can be removed from the bending frame to serve as a powerful jack—or with standard attachments to pull, push, spread, press, lift and lower—easily, accurately, safely and fast!

Porto-Power is fast becoming indispensable hydraulic service equipment in maintenance and electrical work, production plants, shipyards, construction companies and repair service organizations.

If you have a Blackhawk Pipe Bender be sure you know *all* its uses. If you'd like to have one, call your industrial supply distributor or write Blackhawk for complete information on Porto-Power in 7, 10, 20 and 50-ton capacities.

BLACKHAWK

BLACKHAWK MFG. COMPANY
Dept. P20125, Milwaukee 1, Wisconsin
Rush new Hydraulic Equipment
Bulletin V-43 to us.

Name.....

Company.....

City..... State.....

Advertising In This Issue

Acme Electric & Mfg. Co.....	126	General Luminescent Corp.....	212	Radio Corp. of America.....	36, 172
*Adam Electric Co., Frank.....	25	Goodrich Chemical Co., The B. F. ...	30	Reading Electric Co., Inc.....	194
*Aerovox Corporation.....	216	Goodrich Electric Co.....	211	*Reliance Automatic Lighting, Inc.....	196
All-Bright Electric Co.....	28	*Graybar Electric Co.....	44	Republic Steel Corp.....	116, 117
*Allen Co., Inc., L. B.....	224	*Greenlee Tool Company.....	215	*Revere Elec. Mfg. Co.....	200
*Allis-Chalmers Mfg. Co.....	5, 6, 7, 9	Guth Co., Edwin F.....	106	Rittenhouse Co., A. E.....	19
*All-Steel-Equip Co.	20	Harnischfeger Corp., P. & H.....	74	*RLM Standards Institute, Inc.....	99
*American Transformer Co.....	19	*Hazard Ins. Wire Works Div... 4,	32	Robbins & Myers, Inc.....	167
*Anaconda Wire & Cable Co.....	42	Holdenline Co.....	129	*Roller Smith Co.....	150, 151
*Appleton Electric Co.....	2	Howell Electric Motors Co.....	121	Royal Electric Co.....	203
Armstrong Mfg. Co.....	224	*Hullhorst Micro Tool Co. (Div. of		*Russell & Stoll Co.....	213
Arrow-Hart & Hegeman Elec. Co..	136	Toledo Standard Comm. Co.) ..	200		
Associated Projects Co.....	214			*Sangamo Electric Co.....	80
*Associated Research, Inc.....	202	*Ideal Commutator Dresser Co....	40	Searchlight Section.....	226
*Auth Electric Specialty Co.....	192	*Illinois Electric Porcelain Co.....	22	*Sherman Mfg. Co., H. B.....	110
Automatic Electric & Mfg. Co.....	218	*Ilasco Copper Tube & Products Co.	208	*Simplet Electric Co.....	200
		Insto-Gas Corp.....	182	Simplex Wire & Cable Co.....	153
Bakelite Corp.	17	*Insulation and Wires, Inc. 155, 159,	207	Sola Electric Co.....	127
Bell Sound Systems, Inc.....	200	International Register Co.....	221	Solar Electric Corp.....	210
*Benjamin Elec. Mfg. Co.....	107			*Sorgel Electric Co.....	205
*Biddle Co., James G.....	24	*Jefferson Electric Co.....	140	*Spang-Chalfant.....	180
Blackhawk Mfg. Co.....	227	Jenkins Bros.....	198	*Specialty Porcelain Works.....	191
Brach Mfg. Corp., L. S.....	226	*Johnson Bronze Co.....	157	*Speer Carbon Co.....	202
*Briegel Method Tool Co.....	149			*Spero Electric Corp.....	88, 89
*Bright Light Reflector Co.....	184	Kahn Mfg. Co., Inc.....	90	Square D Company	
Bryant Electric Co.....	78	Kato Engineering Co.....	222	Inside Back Cover, 176	
*Bulldog Electric Products Co....	174	Kirkland Co., H. R.....	224	*Standard Transformer Co.....	12
*Burke Electric Co.....	76, 77	*Klein & Sons, Mathias.....	186	Star Electric Motor Co.....	115
*Burndy Eng. Co., Inc.....	21	Kondu Corp.....	218	Steel & Tubes Division.....	116, 117
		Kuehl & Son, D. S.....	224	Stockwell Transformer Corp.....	170
Century Electric Co.....	145			*Superior Carbon Prod. Co., Inc....	156
Certified Ballasts Mfrs.....	125	*Leader Elec. Mfg. Corp.....	93	*Sylvania Electric Products, Inc....	73
Chelsea Products, Inc.....	29	Leland Elec. Co.....	161	*Syntron Company.....	216
Chicago Exp. Bolt Co.....	222	*Lighting Products, Inc.....	84		
Clark Controller Co.....	15	*Lint, Clyde W.....	222	Tal's Prestal Bender, Inc.....	212
Commercial Metal Prod. Co.....	8	Lloyd Products Co.....	193	Thomas & Betts.....	26, 27
Crescent Ins. Wire & Cable Co..	166			*Thompson Electric Co.....	83
Crouse-Hinds Co.	183	*McGill Mfg. Co.....	130	*Toledo Standard Commutator Co..	200
Curtis Lighting, Inc.....	91	McGraw-Hill Book Co....	210, 214, 220	*Tork Clock Co.....	224
Cutler-Hammer, Inc.	112	*Metropolitan Device Corp.....	1	Trico Fuse Mfg. Co.....	157
		Metropolitan Elec. Mfg. Co.....	197	*Trumbull Electric Mfg. Co.....	16
Davis Transformer Co.....	170	Miller Co.	98		
*Day-Brite Lighting, Inc.....	122, 204	*Mineralac Electric Co.....	220	Union Insulating Co.....	204
*Dow Corning Corp.....	178	Mines Equipment Co.....	217	*Unistrut Products Co.....	134
		Mitchell Mfg. Co.....	103	*United States Rubber Co.....	163
Edwards & Co.....	195	Moe-Bridges Corp.....	131	*Universal Clay Products Co.....	191
*Efficiency Elec. & Mfg. Co.....	159	Monarch Fuse Co.....	164	Universal Tool Co.....	226
Electric Equipment Co.....	226	*Monitor Controller Co.....	171	Universal Wire & Cable Co.....	226
Electrical Testing Labs.....	102	Multi Electric Mfg. Co.....	220		
Electro Mfg. Co.....	86, 87	*M & W Electric Mfg. Co.....	216		
Electromode Corp.....	219			Virden Co., John C.....	90
Employment.....	226	National Elec. Products Corp....	37		
		*North American Electric Lamp Co.	222	Wagner Electric Corp.....	147
*Fairbanks, Morse & Co.....	189			Walker Brothers, Inc.....	185
Federal Electric Products Co.....	168	*Ohio Carbon Company.....	114	*Ward Leonard Electric Co.....	196
Fleur-O-Lier Mfrs.	96, 97	*Okonite Co.....	4, 32	*Ware Brothers, Inc.....	160
Fluorescent Fixtures, Inc.....	90	*Onan & Sons, D. W.....	156	Watco Engineering, Inc.....	100, 101
Fostoria Pressed Steel Corp....	104, 105	Operadio Mfg. Co.....	194	*Westinghouse Electric Corp. (East	
Frankel Connector Co.....	210			Pittsburgh).....	35, 110, 119
*Fullman Mfg. Co.....	223	*Paine Co., The.....	158	*Westinghouse Electric Corp.	
		Paragon Electric Co.....	124	(Lamp Div.).....	132, 133
Garden City Plating & Mfg. Co....	31	Pass & Seymour, Inc.....	128	*Westinghouse Electric Corp.	
*Gedney Electric Co.....	226	*Pelham Elec. Mfg. Co.....	188	(Lighting Division).....	187
*General Electric Co. (Bridgeport)		*Penn-Union Elec. Corp.....	206	*Westinghouse Electric Supply Co..	130
Back Cover, 209, 225		Pittsburgh Reflector Corp.....	85	*Wheeler Reflector Co.....	201
*General Electric Co. (Nela Park)		Plastic Wire & Cable Corp.....	169	Where To Buy.....	224
83, 94, 95, 108		Porcelain Group.....	191	Wiremold Company.....	199
*General Electric Co. (Schenectady)		*Porcelain Products, Inc.....	120, 191	Wodack Elec. Tool Corp.....	224
Inside Front Cover 10, 11, 13, 165,	190	Pyle-National Co., The.....	160	*Wurdack Elec. Mfg. Co., W. M.....	23
				Youngstown Sheet & Tube Co....	14

★ These companies have supplied additional buying information on their products in the 1945 edition of the Electrical Buyers' Reference

SAVE TIME...

CUT MAINTENANCE COST

with **SQUARE D** Circuit Breakers

SQUARE D's
Circuit Breaker Line
is Complete!

You save TIME two ways

•Harmless momentary overloads pass without breaking the circuit, due to a time-lag feature built into every Square D Circuit Breaker.

•Restoration of service is quick and easy. No replacing of fuses. A simple flip of a switch restores current after the cause of the short or overload has been eliminated.

You save MONEY two ways

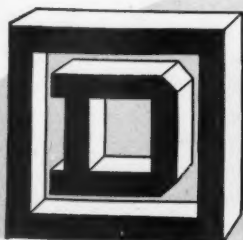
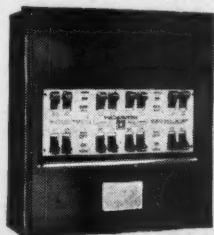
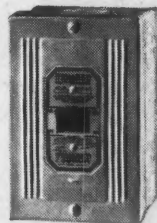
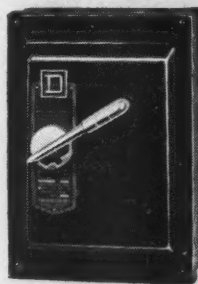
•Fuses are eliminated—no replacement of parts is necessary.

•Electrical equipment has constant proper protection, because every Square D circuit breaker is factory-sealed and consequently tamper-proof.

You'll find that Square D understands your special problem, and builds exactly the circuit breaker you need. Let your nearby Square D Field Engineer show you how a modern circuit breaker installation can give you smoother plant operation at lower cost. Or . . . write for Industrial Circuit Breaker Bulletin. Address Square D Company, 6060 Rivard Street, Detroit 11, Mich.

See our Catalog in Sweet's
. . . or write for Bulletin . . .

Square D has the *right* unit for any installation. You may select from a wide variety of enclosures, including general-purpose, rain-tight, dust-resisting, and explosion-resisting. Capacities range from 15 to 600 amperes, up to 600 volts.



SQUARE D COMPANY

DETROIT

MILWAUKEE

LOS ANGELES

General Electric Introduces

PVX

REGISTERED TRADE MARK

Non-Metallic Sheathed Cable

(With Thermo-plastic Insulated Conductors)

Here is a new high-quality, light-weight, small diameter cable that will give long service and can be installed quickly and easily. Its Type T conductors are insulated with thermo-plastic compound. These conductors are protected with an improved crushed-paper armor and covered with a tough over-all braid. The whole assembly can be freely stripped.

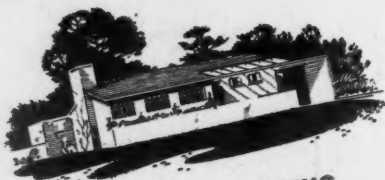
THERMO-PLASTIC INSULATION

The thermo-plastic conductor insulation has long life, is high in dielectric and mechanical strength and is resistant to oil, acids and alkalis. This insulation and the over-all braid are flame and moisture resistant.

WIDE APPLICATION

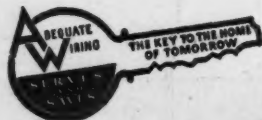
PVX non-metallic sheathed cable is available with two or three conductors in sizes 14 to 4 without ground wire. It is recommended for open and concealed work in all buildings where permitted by local codes and the National Electrical Code. It is approved by the Underwriters for 60 deg. C operation.

FOR FURTHER INFORMATION on G-E PVX cable or G-E conduits or wiring devices see the nearest G-E Merchandise Distributor or write to Section CDW-1254-18, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Conn.



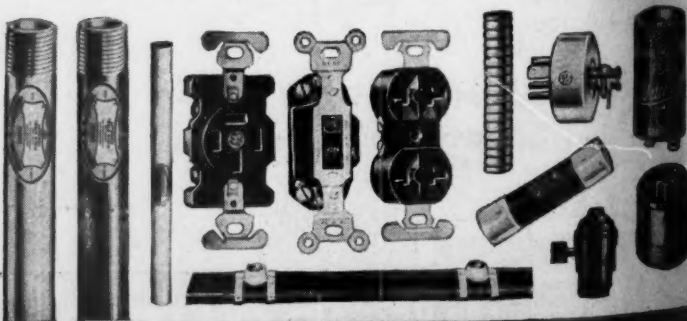
POST WAR WIRING

Frederick P. Coffey, Pres. Anderson-Coffey Co., Inc., electrical contractors, Boston, Mass. says, "Adequate wiring contrasted with the emergency wiring caused by war-time shortages is most essential to the post-war building plans of the electrical contractor and those he serves."



G-E CONDUITS AND WIRING DEVICES

General Electric also offers for your wiring needs: G-E White zinc-coated conduit, G-E Black enamel-coated conduit, EMT, flexible metal conduit and hundreds of switches, lampholders, outlets, fuses, etc.



GENERAL ELECTRIC

iam-
e in-
tors
nese
ned-
aid.

life,
d is
and
ant.

with
out
on-
cal
red

on-
ise
and
nn.

nc-
tal
te.